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NATURE AND THE DOCTOR[1]

By Dr. PEYTON ROUS

ROCKEFELLER INSTITUTE FOR MEDICAL RESEARCH, NEW YORK

EVERY good doctor is a naturalist, and there is none more whole-souled or with a larger task. It is no accident that so many medical students have ranged through the fields as boys for rocks or plants, or that John Hunter while at the zenith of his London practice took time to inquire into the structure and economy of whales. To be an ardent observer seems the best of qualifications for the study of medicine. That it is not, though it is the first.

The doctor has always deemed himself eager to listen to Nature and to carry out her commands. Her name has been as often on his lips as that of Liberty on those of the social philosophers. Always he has spoken of aiding her, of not offending her, of letting her take her course (as if she would not take it anyhow by hook or crook), and time and again he has invoked the *vis medicatrix naturae,* conceding that "Nature is the best physician," an admission not the less wise because the fact has so often been staringly evident. Yet with all said it remains true that his relations with Nature have not been continually happy. In the great Oxford Dictionary, under head four, subhead eleven, section C of the meanings given for the word "nature," one finds the following: "Nature—contrasted with medical skill or treatment in the cure of wounds or disease." When first read this seems an innocent and even an encouraging usage; for it stresses the surgeon's success in changing the natural course of events in acute appendicitis, and the physician's in diabetes or pernicious anemia. One becomes for the moment complacent. And then, reading on, one notes just below in the dictionary, under section D, a companion statement, "Nature—contrasted with art," and there come to mind certain recent forms of art which seem expressive of a lively disagreement with nature. Then one thinks of the history of the medical past—of the many centuries

[1] Convocation address at the Medical School of the University of Michigan, October 1, 1938.

during which the phenomena of disease were hid almost wholly away from the doctor, of his ignorance, opinionation and well-intentioned rashness during that time, of the reticence, obstinacy and conservatism which Nature still shows; and one becomes uncertain about the present. Can it be possible that in the statement, "Nature—as contrasted with medical skill or treatment," the doctor of to-day is not merely involved but in some degree reproached? How does his relationship with Nature really stand? Is he actually at odds with her on some points?

The three tasks set every human creature, to see, to know and to do, are notably difficult in the case of the physician: he has to perceive disease phenomena, to understand them, and to cure or at least make them tolerable, preventing future instances. The difficulty with this task has been that sick and well alike have forced the doctor to act before he could know, and to assume, for practical purposes, that he knew before it was possible for him to perceive. Furthermore, he has had to be infallible: error could have no place in the reckoning. A horrid fix this for any reasonable man, and none would have let himself in for it except for the dire situation of his fellows. Throughout countless years people all about the doctor have cried to him, "Why don't you do something?", and disease has cried even louder. He has had to do it, to do his ignorant and erring best. This is still his situation as concerns not a few ills. Each case of paralysis agitans, every inoperable cancer that he sees goads him toward action. He must still treat the insane without knowing why they are so. Yet now at last he has to a large extent worked things around into their proper order; and what is even more important, he sees where next to direct his energies and how to bring them to bear.

This happy state of affairs is essentially recent, and it is due far less to the age-long heaping up of knowledge than to the modern approach to the unknown. Who was it said that discovery results from chance and the prepared mind? The prepared mind of nowadays makes its own chances. It is not content with what comes its way but devises occasions, goes out to find worlds of which there may be no token. So it is that the doctor sets forth to discover. He has become a passionately enterprising observer. He invents instruments and technics with complete assurance that they will disclose things worth while, though he may not know what. Knowledge has come to him in the past mostly through experimentation—which began with the first dose ever given to a sick man: and now he is determined to make the experimental method yield everything that is in it. This decision is not peculiar to him: as you well know, a furor for experimentation has seized of late upon all thinking humanity. It has been applied even to the most delicate and lovely of human relationships, not within casualties at times, as one may remark in passing. But the sick man is not the worse because of the expansion of the doctor's inquiries; curiously enough, the patient is less experimented upon than ever before. When all was ignorance, all inevitably was random experimentation or rule of thumb in coping with disease. But in proportion as the doctor has got to know more and more of the human body he no longer makes shift in these ways but resorts to purposeful moves. Furthermore, as an experimenter he has found that the major laws which rule in the body of animals rule with a striking particularity in the human organism as well; and from the study of diseased lower creatures he has learned about man.

The sick have always had more signs and symptoms standing plain to view than the doctor was able to note, even when he had only the outside of the human creature to scrutinize. One might think that the ancient physicians, Greek, Arabic, those of medieval Europe, possessed of no instruments, other than their own senses, wherewith to perceive, would have covered the narrow field accessible to them, that they would have noted and described and categorized all that unaided man could see or hear or smell of common illness. There were those of course who thought that they did so; but we realize that they fell short and that not even now has this limited task been completed. For generations doctors have been schooled more earnestly in observation than any other large group of men. Circumstances teach it as a skill to poker-players, horse-traders and politicians; poets are born with it; but medical students are drilled in it, and innumerable occasions drill the physician. Nevertheless, as you and I know, an acute doctor can still discern new signs and symptoms in diseases long held wholly familiar. It was only yesterday in medical time that those little spots on the inside of the mouth were pointed out, which help so much in the recognition of measles. And when it comes to a comprehension of the workings of the normal mind how little do we apprehend of what any one with a good brain of his own might find out! It has always been to man's interest that he should realize not only what other people were thinking but what went on in his own head—that he should understand human nature as it is called. Time and again people have solemnly counselled one another, "Know thyself!" Yet of late it has become plain that even the doctor has perceived but a small part of the mental workings of healthy man, let alone those of the sick, and that there are reaches of thought far beyond its immediate spectrum. One might have supposed that some of those subtle individuals existing in all ages, to whom guile has been a pastime and thinking a diversion,

would have discovered these reaches and made them familiar. The opportunities were there and the technical means, namely sharp and capable mentalities. Nevertheless, the Greeks had no word for personality, much less for introvert.

Such examples stress the need for a frontal attack on the unknown. This now seems so inevitable that one wonders why it was not undertaken many centuries ago. The impediment lay in the second of the doctor's tasks, that of interpreting what he saw. Observing seems less necessary when all is sufficiently explained: and what one sees looks different in the light of explanations. The old doctor had to have these if he was to attempt cure in any rational way, and to be rational was his first need because the unknown loomed so huge. Only his reason could keep him from falling into confusion and fear. His situation was abominable. He had to try to understand for practical purposes what was happening in an organism whose feet swelled or whose arm pained when the trouble really lay in the heart, and who felt strange thrills in the heart when sexually attracted to the female. He did not know what all this meant, but he could think about it and think he did with every wit. He saw the same trains of events occurring again and again, with death or health or incapacity as their outcome; and he made up explanations which were so satisfying that they had to be true. He propounded "systems" of medicine (text-books still flaunt the term) which were so beautifully imagined that they made further search for the causes of disease an impertinence. The three humors explained all, or the four elements, or an Archaeus which sat in the stomach and issued orders to the other organs.

This effort to explain phenomena before they were fully perceived was not unique with the doctor, though his needs led him to push it to an extreme. It has been the bane of discovery in every field all along. While man is a curious animal the vice of his curiosity is the ease with which it can be satisfied. He can only feel comfortable when things have been reasoned out; and insisting upon an explanation he becomes its immediate victim. Samuel Butler asserted that man really does not wish to know, that all he desires is tranquility of mind, or, as Butler wickedly put it, to have "the peace that passeth understanding." Certainly explanations have always gone far to content doctor, patient and patient's friends. They went very far indeed when one could perceive nothing of what went on beneath the skin during life and seldom looked under it after death. There were not enough facts then to keep ideas in their place.

This is not an effort to disparage the past but to understand it, as bearing upon the present. It had its great medical discoverers, as modern in their point of view, as clear-sighted, as any of to-day. Their names are too many to tell over. But these men changed material situations far more than they did the general attitude as affecting discovery.

The old doctor, then, had not only to cope with the unknown but with his preconceptions concerning it. These acted to keep him from seeing straight, from hearing clear. How far they could mar his perceptions can be judged from a trivial incident of to-day. A man engaged for many years in medical research, and hence accustomed to observing, bought a player piano of the sort that gives out sound in proportion to how hard one works at pumping it. The salesman showed him a lever and told which way to push it for the music to swell loud or grow faint. For many months he thrust that lever in the wrong directions, toward loud when he wanted faint and *vice versa,* never discovering his error but at length informed of it by a tuner. True, he had managed to compensate for his mistake in some degree by pumping strongly for loud music and mildly for soft. But the worst of the whole thing was that, when finally told, he hated to have to readjust his method to the truth. He had become so accustomed to doing the wrong thing well that it satisfied him. One can see how an early American doctor, deft in the art of bleeding, making of it a technical as well as an intellectual rite, would have overlooked the damage it caused and have clung to its use.

If preconceptions hampered observation, they hamstrung inference. Now we try to be dissatisfied with explanations for phenomena not wholly understood: but are we always successful? Certainly to the medical student that text-book still seems most worth while which explains best. And he admires those instructors who appear bright and sure in their replies, detesting such as wander uncertainly through the laboratory, qualifying their answer to every question, and obviously oppressed with what they do not know. The student sees knowledge as exquisitely sharp and clear because his instructors have not had time to dwell upon its blurred outlines and nuances. Consequently, the questions sometimes asked in eager good faith by his own family, whether to wear a ring against rheumatism, or carry a horsechestnut in the pocket to ward off asthma, seem profane, almost obscene. They may provoke him to be frantically dogmatic and render him medically useless in his own home.

This confidence that knowledge is precise can not last more than a year or two; it is shaken out and away by the facts that buffet the young practitioner from every side. As he goes on with his life he sees the impossible prove real so often that he becomes a humble as well as an ardent observer. The discovery of the Roentgen rays may be said to have ushered in a medical era characterized by increasing surprise and

humility. It is difficult to realize that only a generation ago men deemed cod liver oil a household remedy perpetuated by superstition, and doubted whether sunlight had any virtue beyond the psychical. They then thought of foods wholly in terms of fats, carbohydrates and proteins, mentioning salts, condiments and spices merely for completeness sake, since there were no calories in them and calories were what counted. In that confident period the doctor had suddenly learned so much through his own efforts that he had become mind-proud. Now the empirical good has once again made its weight felt: and we are again prepared to take hints from the past experience of the race on how to maintain health, and to assume that there may be reason in them, though we know it not. The doctor looks eagerly and profitably into quaint notions, as for example that maggots may help in osteomyelitis by devouring the dead bone.

In those Dark Ages of medicine when thinking made things so, there were immense opportunities for the wrong sorts of men, those who were not naturalists, but who had the endowment of visionaries, oftentimes religious. The desire to do good is a magnificent reason for wishing to become a doctor, but unfortunately it is no sign of fitness. Certainly one would not care to have a great poet or artist as one's physician, no matter how much he knew. For what these see they transmute. A little poet, a minor artist, those who draw their main strength from the sensitive perception of realities, yes, they will do better than well in coping with disease: and there have been many such amongst good physicians. But the visionary is an unnaturalist: as a doctor he runs amuck. He becomes the most dangerous and effective of all quacks, limpidly sincere and often lovable as a person, carrying his fellow mystics along with him joyfully, and dominating ignorant folk through the vigor of his convictions. In the old days the honest mystic had every chance to do the harm of his beliefs. Now he stifles in the atmosphere of medicine, its facts harry him, and he seeks the wide air of occupations in which there are more unconsidered variables.

How has this come about? It has come through the demonstration that this disease and that, more and more of them with every year, are entities as real as so many pebbles; and that the happenings for which they are responsible within the body are not nearly so haphazard as the rolling of pebbles downhill in response to physical laws. No need to remark to this audience that when one looks into the dead the wonder is in many cases that they lived, so gross has been the damage to organs and so arrant the interference with function. The efforts of the organism to survive are writ just as plain. For the body does not bear injuries meekly; it has not renounced or been absolved from a single law because it can not keep its temperature normal or digest its food. Though men term it disordered, order still prevails in it, though of a different sort. It has recourse to every possible stratagem of functional readjustment and repair, compounds felonies, fights rearguard actions to the last; and the marks of old lesions often disclose unbelievable victories. Walt Whitman could have sung a grander hymn to the body if he had seen all this. The best of the matter from the doctor's standpoint is that what he now perceives of bodily recourses and reactions he realizes to be inherently understandable, though it may not as yet be understood. When at last he lays bare an ill it does not prove to be a morass of the unknowable. Nature's activities have not become more mysterious on close scrutiny: they have but become more vast.

Nevertheless, as you well know, misbegotten, *a priori* philosophies explaining all of disease and all its cure are still rife in civilized communities. But now doctors as a class go free of them. It is the laity amongst whom they make play. Yet a clever new thought affecting the interpretation or treatment of disease will always take strong hold on the doctor. Anybody who scans that microcosm, the *J.A.M.A.*, for the last 30 years can follow the rise and fall of many an alluring idea. It spreads swift as a contagion, is acclaimed, utilized everywhere, but at long last begins a lingering disappearance from the literature. Where are the opsonic index, the ninhydrin reaction of yester year? The clever idea spreads so fast not only because of the urgency of human need, though this is the prime reason, but because doctors are still school men in some degree, easily governed by ingenious thoughts, rising with enthusiasm to notions that are attractive, and loving to think and work and discuss in company. The ill-founded concept is relinquished slowly, not alone because there may be nothing wherewith to replace it, but because doctors are loathe to believe that such an excellent conceit should not be Nature's as well as their own.

Though the doctor can no longer be a metaphysician, much less a mystic, in his interpretation of disease processes, he yet must recognize the force of the mystical point of view. While mystics do not have a different sort of measles, yet asthma is no less real because provoked by the sight of an artificial rose. According to Mr. Dooley, who, as some will remember, held forth at the time when our soldiers were dying of typhoid by the thousand during the war with Spain, "The man who taught us to boil our drinking water did a dom sight more for us than the feller who said 'Hitch your wagon to a star.'" The worst of this beguiling philosophy is its pragmatic appeal, as no one sees more clearly than the doctor, who made the discovery that in those days drinking water had to be

boiled. He knows that the potential influence of the mind over the body has been no whit diminished by the discoveries which have reduced a large part of what used to be deemed spirit to rather deplorable flesh. It is even his ambition to make the mind influence the body more than it ever has, and in ways productive of good; indeed, he already does this in certain risky yet rewarding combinations of medicine with inspiration. He knows that the mystic has a place and a power in human affairs, that he constitutes a saving opposition to received ideas, leavens the human lump. Yet he realizes also that the mystic can not be a wise physician.

The third of the doctor's tasks, that of setting things right, is the only one that the laity really care about. Here is where in all ages there has been the physical devil to pay whenever idea has prevailed over fact. Too often the physician of the past has been unable to see that his triumph of mind over matter was an empty one. Just recall in this connection Hawthorne's story, "The Birthmark," written less than a century ago in commentary on his own times, which tells of the young doctor trying to remove the naevus from his wife's face, who watched it pale and disappear, never noting that as it did so his wife died. The efforts determined by philosophies of medicine were in many cases far worse than aimless: misdirected, they had back of them all the force of beliefs strongly held.

Such was the state of affairs for hundreds of years up shockingly close to the present. During this time the well-educated European doctor was often a St. Thomas Aquinas of the body. But you will recall that St. Thomas and the other school men, whose task it was to reconcile logic and theology, had to let logic go whenever there was conflict. The doctor was under no such compulsion. When his logic was contradicted by happenings within the patient, the latter often bore the brunt of the decision.

There was of course a fairer side to the picture. In every time there have been men, like Paré, who looked with clear, shrewd eyes upon illness, were adroit in doing the possible, and for the rest stayed their hands.

Even when the old doctor was not empowered by rationalization, when they had not made of him a doctrinaire, there yet existed a strong reason why he should persist in a way of treatment that appeared to do harm. This reason, well understood by him, was that no single patient could possibly serve as the touchstone of his methods, owing to the diversity of human illness and of man's constitution. Hence he wrote off bad consequences, disregarded demonstrations against him by the individual sick body. Facts may force people to their knees, but they get up again when they have an idea. Of no one has this been more true than of the doctor. Take Benjamin Rush, for example, a hard-headed, sensible man. He was at his wit's end to treat yellow fever in Philadelphia in 1793, when he found one night, while searching for what had been done previously, that a Scotch physician had thought violent purgation to be effective in the Virginia epidemic of 1743, and furthermore had advised against "an ill-timed scrupulousness about the weakness of the body." Thenceforth Rush purged and bled with all the energy of a courageous and devoted character. So doing he gave impetus to the American school of bleeders, and they continued to take toll until far into the next century. Like all pledged to "systems" of treatment or medical philosophies, they suffered much for conscience sake and led uneasy, contentious lives. Believing that they alone could be right they fiercely detested efforts of other sort at cure. Rush was not on speaking terms with Dr. Adam Kuhn, the grave German physician who alternated with him in the treatment of the Drinker family.

There was the more reason for the old doctor to hold fast to his ideas, because both his ignorance and the public forced upon him the rôle of seer. The sick have always thought of doctors not as they are but as they would wish them to be. They place trust, they are not prepared to excuse. For sickness becomes a double burden when the doctor seems as likely to make mistakes as all the other people that you and I know. He has accepted this reliance upon him as implicit in his situation, and the result has been, not an absurdity but a relationship fine in human values. The truth is that the doctor has had to be self-confident to gain best results. Emerson wrote in his journal in 1837: "The same complaint I have heard is made against the Boston Medical College as against the Cambridge Divinity School, that those who receive their education want faith, and so are not as successful as practitioners from the country schools who believe in the power of medicine." Yet this faith has not always worked for fresh discovery as concerns disease. The gold-headed cane of the eighteenth century doctor, his dignity, the ritual formality of his visits to the sick room, though aiding the patient's state of mind, often trapped him into thinking too well of his own abilities and fenced him in this way from nature. The parade of efficiency in the modern hospital, its cool and silent whiteness, its swiftness in action, the deference to the chief on "rounds," the whole arresting contrast with the outside world, mean more than a task undertaken with the ailing body, and release for the patient from responsibility for himself—they imply that things will actually be done with more understanding and more surely than in any other sphere of human effort. But while in this way they help the sick, to no negligible extent they bring risk to the doctor. Their effect on him

might be very damaging were it not warded off by the disclosures of the clinical laboratory, the x-ray department, the postmortem room, which keep him chastened and effective.

In the old days thought on how to undertake curing took the same two lines as to-day: One could either give natural processes their head and urge them on, or mix in and try to direct events. These alternatives were frequent in ancient story. The heroine, coming upon the hero wounded and alone in the forest, dressed his wound with simples and gave him cooling drinks. He got well. The other literary recourse was more complex. He did not get well, so the heroine had him transported by litter to a leech who administered a draught of such potency that sometimes he had a major convulsion, and in any event passed into a trance from which several days later he woke up cured, and often with a far more agreeable personality. What the doctor gave had shaken things at their foundations, had averted chaos.

There was reason in the leech's violence if not sound reason; and it was the outcome of earnest observation. To the ignorant watcher disease and death seemed to have little of that order which reigns in the healthy body. The doctor saw what appeared to be a falling away from standards, a dissolution in progress that was far along before the organism gasped its last. Nature seemed incapable, all was disordered. These words dissolution, disorder, clearly express what the doctor believed that he witnessed and they give his interpretation of it. Serious illness was often the more appalling because it seemed a muddle. What more reasonable then than to try to restore order by drastic means? Out of such thinking came the dogma that violent diseases demand strong remedies. And thence, in some part also, that perturbing contrast to be found in the dictionary of to-day between nature and medical skill or treatment.

Now we no longer see disease as disorder, though the term still holds place as a synonym. We perceive that no matter how abnormal a body state may be, it is still natural. To the scientist, even the iridescence of decay, the scum on the pool, are the expression of laws which might be termed wholesome if the word had any meaning in such connection. And with the extension of this view to the laity has come a vast relief. For sickness was indeed appalling when it seemed to come out of nowhere and to be obedient to nothing. The special horror of the pestilences was that they walked in darkness. This horror is felt still in relation to a few diseases, notably cancer, but even in these the doctor can perceive laws. To the public yellow fever is now only a virus disease transmitted by mosquitoes, and the plague a bacterial infection. Such knowledge would be fortifying, even if they came again. And understanding has brought with it a common-sense attitude. The campaign against the venereal diseases can be so free-spoken because their causes are matters of fact.

The doctor himself has become the complete realist that he has always wanted to be. Facts are his familiars and mould his thought. He perceives that while he can hurry Nature or impede her, humor her, help her or narrow her field of activities (as when the surgeon takes out an organ), he can not change her ways, much less flout them. Patiently achieved in the course of long time, they will not soon be let go. But he sees too that in many respects he is already wiser than the body, which works from precedent to age-old precedent, and when confronted with crises resorts to the same immemorial gambits. Frequently now he can go Nature one better in healing the sick through exploitation of the resources that she provides, as for example the hormones. He still cures in many ways that he does not understand, but now he begins to feel a slight humiliation when so doing. In his primary task of observation he is more than ever behind. Despite all his instruments he is still hampered by sheer inability to perceive, while furthermore the scope of the perceptible has broadened incredibly. It provides one of the greatest of present dangers to the doctor's relations with Nature. So much of detail there is for him to look upon and realize as to bring risk that at times he may not see the organism as a whole. Yet this is his culminating duty. The wisest physicians will always be general practitioners in the sense that they deal in thought with the whole case.

In the eighteenth century the activities of the doctor as a field naturalist sometimes brought great discovery. Withering was the very man to have been told that a "wise woman" in a nearby village cured dropsy with a decoction of herbs. There were more than twenty of them in the mixture, yet, as he remarked, the problem presented no difficulties "to one conversant in these subjects"; the fox-glove, the digitalis, was the essential ingredient. For Withering knew botany, and had already produced a compendium of British plants that was to be used for generations after him. Jenner did not have a casual chat with a milkmaid and then take a fling at vaccination. Living in the country and keen about animals of all sorts, his observations convinced him that cow-pox and the "grease" in horses represented smallpox in an innocuous form; and after his first successful inoculation he waited nine years, rejecting material after animal material, before he got one that seemed right in his experienced view. With it he made the test which justified publication.

Now as field naturalists we roam chiefly within the body. Bacteriology has supplanted botany: and the

habits of organs seem more important than those of animals. Cushny remarked as long ago as 1915 that all the great therapeutic discoveries of the preceding 50 years had stemmed from the laboratory. Nevertheless medical science now derives strength more than ever from the study of life in the lower forms. It is not merely that cows have tuberculosis and pigs influenza. There exists a physiological kinship amongst organisms of the most incongruous kinds. The realization that Nature does not conform with man's meager imaginings but far exceeds them has always been one of the chief delights of the investigator. Could common sense have prophesied that observations on certain cells wandering within the negligible body of a skipping little crustacean, a waterflea, would tell how bacteria can be met and destroyed when they invade the human being? To find out anything from tobacco plants that will apply to human virus diseases seems a wild thought. Yet one can and does. It has dawned upon us, somewhat more than dawned, that the happenings in animals and plants have far greater meaning for us than their forms would imply. These overemphasize the differences in a most deceptive way; for living creatures are joined by their functional principles into a sort of vertical union. The same insulin that works in the cod-fish will save a diabetic man. What takes place within animals and plants is our own vital concern; no natural science but is in some sense our province. And the further the doctor peers amongst organic phenomena the more twos and twos can he see ready to be added up into fours.

Nothing in medicine has bettered so much throughout the years as the doctor's relations with Nature. Now he is more of a naturalist than ever. It may be urged that the change has been quantitative, that Hippocrates would find himself on easy terms with the good physician of to-day. Granted. Yet there are alterations which, though intrinsically quantitative, are qualitative in effect: they make the world look different. And the world of the body looks different now to the doctor, though it is only himself that has changed.

OBITUARY

IN MEMORY OF OTTO HILGARD TITTMANN

AT a meeting of the Board of Trustees of the National Geographic Society held on October 27, the following resolution was adopted on the death of Dr. Otto Hilgard Tittmann, one of the founders of the society and its president from 1915 to 1920:

With profound sorrow, the Board of Trustees of the National Geographic Society records the death on August 21, 1938, of Dr. Otto Hilgard Tittmann, a founder member of The Society.

A member of the Board since 1888, and President of The Society from 1915 to 1920, Dr. Tittmann had an important part in building The Society from a small group of pioneers to the world-wide organization of to-day. His keen scientific mind, his administrative ability, and his loyalty to The Society are recognized by this Board as vital factors in The Society's fifty years of progress.

Dr. Tittmann was an outstanding geodesist of his day. At seventeen years of age, in 1867, he began his scientific career as a member of field parties of the Coast and Geodetic Survey studying the Atlantic and Gulf Coasts. His frequent elevation to higher posts of responsibility in the Survey and his excellent work on special scientific assignments by his Government in the fields of geodesy and astronomy finally won for him, in 1900, the appointment of Superintendent of the Coast and Geodetic Survey.

At the early age of twenty-four years, he was assigned as assistant astronomer of an expedition to Japan to observe the transit of Venus. On his return to this country he continued his field work on the Atlantic and Pacific Coasts, and in 1887 was appointed Chief of the Office of Standard Weights and Measures, then a part of the office of the Coast and Geodetic Survey.

Outstanding among his achievements was his work in connection with the marking of boundaries between the United States and Canada and Alaska and Canada which covered the period from 1893 to 1911, and his researches in the field of geodesy.

In recognition of the valuable contributions of Dr. Tittmann to the National Geographic Society, of his important scientific achievements, of his inspiring leadership, be it resolved that this expression be spread upon the minutes of The Society and that a copy be transmitted to his family.

RECENT DEATHS AND MEMORIALS

DR. EDWIN HERBERT HALL, professor emeritus of physics at Harvard University, died on November 20 at the age of eighty-three years.

DR. JOHN C. PHILLIPS, research curator of birds in the Museum of Comparative Zoology of Harvard University, member of the faculty of the Peabody Museum of Harvard College and president of the Peabody Museum at Salem, Mass., died suddenly while shooting in the woods of New Hampshire on November 14. He was sixty-two years old.

DR. HOWARD A. MCCORDOCK, professor of pathology at Washington University School of Medicine, known for his work on sleeping sickness, died on November 13 at the age of forty-three years.

DR. HIRAM MILLER SHOWALTER, professor of biology at King College, Bristol, Tenn., died on Novem-

ber 12 at the age of thirty-five years. His published papers have been concerned with the cytology and genetics of Mirabilis. For several years prior to his death he was engaged in a cytogenetical survey of the Tradescantias of the Great Smoky Mountains of Tennessee and North Carolina.

FREDERICK CLEMENS ZEISBERG, technical investigator of the development department, E. I. du Pont de Nemours and Company, and president, American Institute of Chemical Engineers, died on November 12 at the age of fifty years.

GLEN P. VAN ESELTINE, associate in research in the division of pomology at the New York State Agricultural Experiment Station, Geneva, died on November 15 at the age of fifty years.

A CORRESPONDENT writes: "William Hudson Behney died on October 28. He was assistant professor of zoology at the University of Vermont, with which university he had been connected for ten years, as research fellow, assistant in zoology, instructor and associate professor. He was granted in May, 1938, a year's leave of absence to work for his Ph.D. degree, having received his master of science degree from the university in 1930. But in September last he was appointed director of the Fish and Game Service of Vermont. Hardly had he begun the duties of this new position, still retaining his connection with the state university, when he was stricken with a serious illness, malignant peritonitis, which three weeks later brought about his death. A young man of only thirty-six years, of remarkable promise and accomplishment, especially in the field of stream ecology and fish biology, Behney's untimely passing has deprived the country of one of the most zealous and devoted naturalists of his generation."

A MEMORIAL meeting of friends, associates and former students of Dr. Abram T. Kerr, who until his death last August had been secretary of the Medical College of Cornell University at Ithaca for thirty-six years, was held on October 30. Dr. Benjamin F. Kingsbury, professor of histology and embryology at Cornell University, presided and spoke of Dr. Kerr's long service at Cornell University; Dr. Dean F. Smiley, medical adviser, spoke of his influence in establishing hygiene instruction, and Professor Simon H. Gage, professor of histology and embryology, emeritus, spoke of him as former student.

AN oil portrait of the late Dr. Charles H. Herty will be presented by the Alumni Society of the University of Georgia to the university, where he was a member of the class of 1886 and where he taught chemistry for many years.

IT is reported in *Nature* that the Council of the Royal Society of Edinburgh, with permission of the Hon. Lord Robertson, have caused to be incised on the house at 14 India Street, Edinburgh, the following inscription:

JAMES CLERK MAXWELL
NATURAL PHILOSOPHER
BORN HERE 13 JUNE 1831

A NEW statue of Carl Linnaeus, father of modern systematic botany, has been erected near the University of Lund, Sweden.

SCIENTIFIC EVENTS

THE ESTABLISHMENT IN THE DEPARTMENT OF STATE OF A DIVISION OF CULTURAL RELATIONS

THE Secretary of State, the Honorable Cordell Hull, has signed the following departmental order establishing in the Department of State a Division of Cultural Relations:

For the purpose of encouraging and strengthening cultural relations and intellectual cooperation between the United States and other countries, it is hereby ordered that there shall be established in the Department of State a Division of Cultural Relations.

The division will have general charge of official international activities of this department with respect to cultural relations, embracing the exchange of professors, teachers and students; cooperation in the field of music, art, literature and other intellectual and cultural attainments; the formulation and distribution of libraries of representative works of the United States and suitable translations thereof; the preparations for and management of the participation by this government in international expositions in this field; supervision of participation by this government in international radio broadcasts; encouragement of a closer relationship between unofficial organizations of this and of foreign governments engaged in cultural and intellectual activities, and, generally, the dissemination abroad of the representative intellectual and cultural works of the United States and the improvement and broadening of the scope of our cultural relations with other countries.

In fulfilling its functions, the Division of Cultural Relations will direct the conduct of exhaustive studies and have responsibility for the elaboration and the carrying into effect of a comprehensive and coordinated plan of activity in this country for the strengthening of international intellectual and cultural relations; it will assist in the preparation and interpretation of treaties in this field; it will supervise the formulation of regulations and procedure necessary for the fulfillment of obligations under the Convention for the Promotion of Inter-American Cultural Relations and other treaties and conventions relating

to cultural relations to which the United States may become a party; it will draft or review correspondence with foreign governments, American diplomatic and consular officers and all other correspondence pertaining to these activities; it will collaborate with the Office of Education and other government departments and agencies, the National Committee on Inter-American Intellectual Cooperation, other educational and cultural organizations and institutions and foreign missions in Washington.

The Division of Cultural Relations will function under the general supervision of the Under Secretary of State and in close cooperation with the geographical divisions.

Mr. Ben M. Cherrington has been appointed Chief of the Division of Cultural Relations.

The symbol designation of the division shall be RC.

The chief clerk and administrative assistant will provide the essential clerical assistance and equipment for the new division, within the limits of appropriated funds.

The provisions of this order shall be effective on July 28, 1938, and shall supersede the provisions of any existing order in conflict therewith.

THE MACDONALD OBSERVATORY OF THE UNIVERSITY OF TEXAS

DR. OTTO STRUVE, director of the Yerkes Observatory of the University of Chicago and joint director of the MacDonald Observatory, situated on Mount Locke in the Davis mountains, has reported to the University of Texas that the polishing of the 82-inch mirror for the MacDonald Observatory of the university has been completed and it "can be safely accepted." Dr. Struve wrote:

> Tests made on October 15 indicate that the great 82-inch mirror is finished. The surface is a paraboloid of 319.66 inches focal length and the actual figure of the glass does not depart from the mathematical shape by more than about one millionth of an inch. This extraordinary degree of perfection is the outcome of exactly four years of gruelling work of grinding and polishing on the part of C. R. Lundin, optician for the Warner and Swasey Company of Cleveland, Ohio. During the past four years astronomers of the University of Chicago's Yerkes Observatory have made many accurate tests of the mirror. But only now are they fully satisfied that the new mirror will be as perfect as their investigations require.
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> The mirror will next be coated with a thin layer of highly reflecting aluminum. Before it is shipped to Fort Davis, two small convex mirrors must be completed, but optical experts believe that this should not require more than a few weeks' work. Shipment will be made before the end of December, and astronomical research with the large telescope will be commenced about the first of next year. By next spring all remaining tests should be completely finished.
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> The 82-inch mirror is at the present time the second largest finished astronomical mirror in the world. It is surpassed only by the 100-inch mirror at the Mount Wilson Observatory, Pasadena, Calif. After the completion of the 200-inch mirror of the California Institute of Technology, the Texas mirror will rank third in the entire world. It is of interest that the three largest astronomical mirrors are all in the United States. The fourth and the fifth are located in Canada, at the University of Toronto Observatory and the Dominion Observatory in Victoria, B. C. The sixth mirror in size is again in the United States, at the Perkins Observatory of Ohio Wesleyan University. A 76-inch reflector is now under construction for the Radcliffe Observatory in South Africa. The University of Michigan is contemplating the construction of a reflecting telescope of more than 90 inches in diameter. The disc for this mirror has already been cast, but no optical work has been started.

WORK OF THE GRAY HERBARIUM OF HARVARD UNIVERSITY

IT is reported in *The Harvard Alumni Bulletin* in an account of the work of the Gray Herbarium that, beginning in early April, 1937, Professor Merritt L. Fernald, '97, director of the herbarium, started field work in Virginia, and made six trips, the last in October, into the coastal plain south of the Rappahannock. This work, made possible through a generous and anonymous gift from a friend of the herbarium, and carried out with the cooperation of Bayard Long, of the Academy of Natural Sciences of Philadelphia, is greatly altering the understanding of the history of life in eastern North America. The fourth paper resulting from the Virginia work, "Local Plants of the Inner Coastal Plain of Southeastern Virginia," with 137 pages, 15 plates and 59 maps, was issued last winter; the fifth paper, of similar extent, is now being issued.

The senior curator, Charles A. Weatherby, has continued his critical studies of tropical American ferns, resulting from his prolonged visit to the European herbaria, where he made detailed notes on, and photographs of, historical type-specimens from which American species were early described. The junior curator, Dr. Lyman B. Smith, has devoted much time and energy to the collection and organization of authentic specimens for distribution to the principal herbaria of the world in the "Plantae Exsiccatae Grayanae."

During last winter and spring, Dr. Eric Hultén, curator of the herbarium of the University of Lund, spent many weeks at the Gray Herbarium, working on his projected flora of Alaska. Dr. Hultén's intensive knowledge of northern floras and the problems of northern biogeography made him a stimulating contributor in the weekly conferences of advanced students. Dr. Harold A. Senn, national research fellow, has completed his detailed study of the genus *Crotalaria*. His extended and important taxonomic monograph and cytological studies will be published as a "Contribution" from the Gray Herbarium. Professor L. O. Gaiser, of McMaster University, whose cytological work on the American genus *Liatris* is throwing

light on its complications, spent much of the summer studying and annotating the material at the herbarium.

Professor Liberty Hyde Bailey, whose first work on the genus *Carex* was published by the herbarium in 1886, made a visit to the herbarium in September, studying, in his eighty-first year, the intricate sources of cultivated plants. Professor Bailey is the only living associate of Asa Gray.

Dr. Kenneth F. Baker, of the experiment station of the Pineapple Producers Cooperative Association of the Hawaiian Islands, *en route* to tropical South America to study and collect wild species of the pineapple group, spent several days in consultation with Dr. Smith, one of the world's authorities on this family of plants, and will later have the assistance of Dr. Smith in interpreting his results. Ernest Rouleau, curator of the herbarium of the University of Montreal, spent the summer at the Gray Herbarium as a special research fellow, studying herbarium technique.

THE EASTERN SHADE TREE CONFERENCE

A MEETING will be held at the New York Botanical Garden in Bronx Park on December 8 and 9 to consider problems arising out of the damage done to trees during the hurricane of September 21. The call for the meeting is being issued by Dr. William J. Robbins, director of the Botanical Garden, at the request of a committee composed of W. O. Filley, forester at the Connecticut Agricultural Experiment Station; Dr. B. O. Dodge, plant pathologist at the garden; and Dr. E. P. Felt, director and chief entomologist at the Bartlett Tree Research Laboratories. Mr. Filley will serve as temporary chairman of the meeting, which will be opened with a short address by Dr. Robbins.

The loss of a million or more good trees in the eastern states during the hurricane which swept up the coast and across New England is the motive of the gathering, which is to be known as the Eastern Shade Tree Conference. The aim is to study the selection and culture of more sturdy, storm-proof trees; to propose a program of rehabilitation of damaged trees; and to endeavor to gain a greater control over tree diseases and pests for the protection of trees in future years.

Some of the special problems incidental to the damage wrought by the hurricane include more concentrated attention to the pests of trees which are increasing in this area. Of special importance is the Dutch elm disease, which is carried by a beetle which breeds in weak or unhealthy trees. Half a dozen other ravaging insect and fungous pests will be taken under consideration at the conference. The problems connected with them are outlined by Dr. Felt as follows:

The gipsy moth, a serious pest of shade and forest trees, has been slowly extending its range westward and has now become abundant in several localities in western New England close to or near the barrier zone. The control of this insect is becoming a general problem.

The European spruce sawfly, a recently introduced species established over much of New England, has caused serious damage to spruce forests in limited areas in Maine, New Hampshire and Vermont and may develop as a destructive pest of Norway spruce.

The Japanese beetle has been steadily extending the range of serious infestation in New Jersey and adjacent areas and is now becoming extremely abundant and injurious in southeastern New York and southwestern New England.

The elm leaf beetle has defoliated many trees in the Hudson River Valley and in New England during the past 40 years. It is more than probable that this insect has played an important part in weakening many of the shade trees which were badly damaged by the hurricane. This is also true of canker worms and forest tent caterpillars.

The willow scab fungus is a disease which has killed many thousands of willow trees in the East. Its control is another of the serious problems for the tree owner. There are, in addition, the Sphaeropsis on Austrian pine and the Cytospora of the Norway and Colorado blue spruces.

THE AMERICAN ORNITHOLOGISTS' UNION

THE fifty-sixth annual meeting of the American Ornithologists' Union was held at the U. S. National Museum, Washington, D. C., from October 17 to 21, 1938, with a registered attendance of two hundred and thirty-three. Fifty-nine scientific papers were read—many illustrated by color slides or films. The three days of program sessions included a like number of evening entertainments; open house at the museum, the annual dinner and business meetings of various sections. On Friday the more than two hundred ornithologists in attendance visited the agricultural research center at Beltsville, Md. Many remained on Saturday for a conducted tour of the National Zoological Park.

Officers elected for the new year were as follows: *President,* Dr. Herbert Friedmann, Washington, D. C.; *Vice-presidents,* Dr. J. P. Chapin, New York City; Dr. J. L. Peters, Cambridge, Mass.; *Secretary,* Dr. Lawrence E. Hicks, Columbus, O.; *Treasurer,* Rudyerd Boulton, Chicago; *Council,* W. L. McAtee, Washington, D. C.; John T. Zimmer, New York City, and Robert T. Moore, Pasadena.

The Brewster Medal award was made to Dr. Thomas S. Roberts for his volumes on "The Birds of Minnesota." One fellow, Dr. Ira N. Gabrielson, Washington, D. C.; two honorary fellows, Eliot Howard, of England, and Jacques Berlioz, of France, and six corresponding fellows, K. A. Hindwood, Australia; Konrad Lorenz, Austria; Wilhelm Meise, Germany; R. E. Moreau, Tanganyika, Africa; Ernst Shuz, Germany; N. Tinbergen, Netherlands, were elected.

In addition to 337 new associate members, eight new members were named: Thomas T. McCabe, Harold Michener, Gayle B. Pickwell, E. Lowell Sumner, Jr.,

of California; Austin L. Rand, New York; Alexander F. Skutch, Maryland; Herbert G. Deignan, Washington, D. C., and S. Gilbert Emilio, Massachusetts.

The 1939 meeting will be held in the San Francisco Bay region of California from June 19 to 23. Dr. Alden H. Miller, of Berkeley, is the chairman of the local committee. Dr. Alexander Wetmore, of the U. S. National Museum, has been named president of the eleventh International Ornithological Congress, which will hold a joint meeting with the American Ornithologists' Union at the Philadelphia Academy of Sciences in May, 1942.

LAWRENCE E. HICKS,
Secretary.

SYMPOSIA AT BROWN UNIVERSITY ON INTERMOLECULAR ACTION

A THREE-DAY meeting on "Intermolecular Action," sponsored by the Division of Physical and Inorganic Chemistry of the American Chemical Society, will be held at Brown University on December 27, 28 and 29. The members will attend the ceremonies dedicating the Metcalf Research Laboratory of the university on Wednesday afternoon, December 28.

In a series of twenty-two scientific papers, thirty-eight chemists will discuss "Gases and Pure Liquids," "Non-Polar Mixtures," "Highly Polar Mixtures," "Polar Mixtures" and "Ionic Solutions." Professor George Scatchard, of the Massachusetts Institute of Technology, chairman of the division, will preside.

Among the speakers will be Professor Joel H. Hildebrand, of the University of California, who was recently awarded the 1939 William H. Nichols Medal of the New York Section of the American Chemical Society for his studies of liquid and solid solutions; Professor John G. Kirkwood, of Cornell University, to whom was awarded the $1,000 American Chemical Society Award in Pure Science for original contributions in the field of intramolecular forces; Dr. F. Loudon, of the Institut Henri Poincaré, Paris, at present visiting lecturer at Duke University; and Professor Charles A. Kraus, of Brown University, president-elect of the American Chemical Society.

Dr. Niels Bjerrum, professor of chemistry at the Royal Veterinary and Agricultural College, Copenhagen, visiting lecturer at Brown University, and Dr. Frederick G. Keyes, head of the department of chemistry at the Massachusetts Institute of Technology, will deliver the dedication lectures on Wednesday afternoon. Dr. Bjerrum's subject will be "The Development of the Theory of Electrolytes," and Dr. Keyes will speak on "Contrasts."

The committee on arrangements, in addition to Professor Scatchard, includes Professors Cohn, Eyring, Hildebrand, Kraus and LaMer; Professor Farrington Daniels, of the University of Wisconsin; Dr. Louis S. Kassel, of the U. S. Bureau of Mines Experiment Station, Pittsburgh; Professor Philip A. Leighton, of Stanford University; Professor Samuel C. Lind, of the University of Minnesota; Wilber G. Parks, of Rhode Island State College; Thomas H. Roberts, of Edgewood, R. I., and Professors Earle K. Strachan and Laurence S. Foster, of Brown University. Dr. Harold C. Urey, of Columbia University, is secretary of the division.

SCIENTIFIC NOTES AND NEWS

THE hundred and third meeting of the American Association for the Advancement of Science will be held at Richmond, Va., from December 27 to December 31. Dr. Wesley C. Mitchell, professor of economics at Columbia University, will preside, and the address of the retiring president will be given by Dr. George D. Birkhoff, professor of economics at Harvard University. The preliminary program of the meeting, edited by Dr. F. R. Moulton, permanent secretary of the association, will be printed in next week's issue of SCIENCE. The first event of the meeting, except the meeting of the executive committee, will be on Monday evening, when a dinner will be given to members of the National Association of Science Writers and to editors of Virginia newspapers in honor of Austin H. Clark, of the Smithsonian Institution, formerly director of the press service of the association. Sir Richard Gregory, editor of *Nature,* will be the principal speaker.

DR. BERNARD SACHS has been elected a corresponding member of the Société Suisse de Neurologie "for eminent scientific merits and the prolific influence of his research work on the progress of neurology."

DR. MORLEY FLETCHER will represent the Royal College of Physicians, London, at the opening of the Royal Australasian College of Physicians. He will be presented with an illuminated address and a replica of the silver wand or caduceus, which was presented to the college by Caius in 1556.

ACCORDING to the *Journal* of the American Medical Association, the State Medical Society of Wisconsin at its annual meeting in Milwaukee presented the gold seal of the society to Dr. Eben J. Carey, dean of the School of Medicine of Marquette University, and to Dr. William Shainline Middleton, dean of the Medical School of the University of Wisconsin. Dr. Carey was honored for his "high accomplishments in medical edu-

cation and research" and for his "perfection of the art and dynamic use of visual education as a means of furthering the health of our citizenry." The seal was awarded to Dr. Middleton "for accomplishments and lofty inspiration in the teaching of students and practitioners, for a quarter of a century of public service and for outstanding influence in the development of a high quality of medical service for the citizenry of Wisconsin."

A DINNER in honor of Professor S. J. Holmes, of the University of California, president of the American Eugenics Society, will be given by the society at the Town Hall Club, New York City, on November 30. Professor Holmes will preside and Dr. Albert E. Wiggam will be toastmatser. The speakers and their subjects will be as follows: Frederick Osborn, "The American Concept of Eugenics"; Professor Henry P. Fairchild, "Family Limitation Necessary to Eugenics in a Democracy"; Mrs. Sidonie Matsner Gruenberg, "The Eugenic Significance of Child Study," and Ralph P. Bridgeman, "The Eugenic Significance of Parent Education."

AT the October meeting of the Indiana Chapter of the Society of Sigma Xi the following officers were elected: *President,* G. S. Snoddy, psychology; *Vice-president,* R. J. Hartman, chemistry; *Secretary,* M. L. Lohman, botany; *Treasurer,* R. L. Kroc, zoology. Dr. Raymond Pearl, of the Johns Hopkins University, lectured on the subject of "Human Fertility."

DR. LEONARD J. PICCOLI, professor of materia medica, pharmacology and physiology at Fordham College of Pharmacy, has been elected the first president of the American Association for the Advancement of Professional Pharmacy.

THE Council of the Royal Society, London, at its recent meeting recommended the following for election as officers and as members of the council at the anniversary meeting to be held on November 30: Sir William Bragg, *president;* Sir Henry Lyons, *treasurer;* Professor A. V. Hill and Professor A. C. G. Egerton, *secretaries;* Sir Albert Seward, *foreign secretary.* Other members of the council: Professor F. C. Bartlett, Professor F. E. Fritsch, Professor M. Greenwood, H. L. Guy, Sir Thomas Holland, Dr. A. D. Imms, Professor C. K. Ingold, Professor G. B. Jeffery, Professor J. Mellanby, Professor J. Proudman, Dr. F. L. Pyman, Professor O. W. Richardson, Professor W. W. C. Topley, Professor D. M. S. Watson, Professor R. Whiddington, Professor R. Whytlaw-Gray.

AT the annual statutory meeting of the Royal Society of Edinburgh held on October 24, the following council was elected: *President,* Sir D'Arcy Thompson; *Vice-presidents,* Professor F. A. E. Crew, Lieut.-Col. A. G. M'Kendrick, Principal J. C. Smail, Professor J. Walton, Dr. James Watt, Professor E. T. Whittaker; *General Secretary,* Professor James P. Kendall.

DR. WILLIAM E. RITTER, who retired with the title emeritus in 1923 as professor of zoology of the University of California and director of the Scripps Institution of Oceanography, observed his eighty-second birthday on November 19.

INGE LYSE, who has resigned as research professor of engineering materials at Lehigh University, has become professor of reinforced concrete and solid bridges at the Norway Institute of Technology at Trondheim.

DR. F. A. WATERMAN, research assistant at the Ohio State University for the past year, is filling the vacancy caused by the appointment of Dr. E. L. Rice as acting president of Ohio Wesleyan University. He has been made assistant professor of zoology for a one-year period.

PROFESSOR G. F. MARRIAN, of the University of Toronto, has been appointed to the chair of chemistry in relation to medicine at the University of Glasgow, in succession to Professor George Barger, who now holds the chair of chemistry.

DR. ROBERT STEVENSON AITKEN has been appointed Regius professor of medicine in the University of Aberdeen in succession to Professor L. S. P. Davidson, who resigned recently. Since 1935 Dr. Aitken has been university reader in medicine and assistant director of the medical department in the British Postgraduate Medical School, London.

PROFESSOR A. F. BERNARD SHAW has been appointed to the joint post of professor of pathology in the University of Durham and pathologist to the Royal Victoria Infirmary, in succession to Professor Stuart McDonald.

THE Committee on Scientific Research of the American Medical Association has made a further and final grant to the University of Chicago in aid of a study of high blood pressure being carried on by Dr. Dallas B. Phemister, of the department of surgery, and Dr. Harwell Wilson, of the department of medicine. The project, which received two prior grants from the committee, is investigating methods of producing high blood pressure in laboratory animals through the nervous structure and through chemical factors.

DR. C. S. MYERS, successively director and principal of the British National Institute of Industrial Psychology since its foundation in 1921, retired from the active direction of its work in October. He has accepted the honorary post of scientific adviser, which will maintain his past contact with the scientific as-

pects of the industrial and vocational work and in which he will continue to supervise its research activities and publications.

WILFRED NORMAN EDWARDS, deputy keeper, has been appointed to the vacancy in the keepership of the department of geology of the British Museum, London, that will arise on the retirement on December 29 of Dr. W. D. Lang. Mr. Edwards is known for his work on fossil plants.

THE Secretary of State for Scotland has appointed J. A. Symon to represent the Department of Agriculture for Scotland on the committee appointed to advise him on matters connected with the administration of the Wild Birds Protection Acts.

DR. LANGLEY PORTER, dean of the Medical School of the University of California, is visiting medical schools of a number of universities of the United States and Canada. Dr. Chauncey Leake, professor of pharmacology, is acting dean during his absence from the university.

DR. PAUL A. ZAHL, of the Haskins Laboratory of Union College at Schenectady, N. Y., left on November 19 for British Guiana, where he will conduct a collecting expedition in the Mt. Roraima area at the tri-juncture of British Guiana, Venezuela and Brazil. Because of the unique isolation of Mt. Roraima, previous expeditions have required months of difficult transit. Dr. Zahl and his group will attempt to fly directly from Georgetown to the base of Mt. Roraima. The present trip is his third to the American tropics to collect living specimens of various Ponerine ants.

DR. GEORGE SARTON, research associate in the history of science at the Carnegie Institution of Washington, gave on November 17 a lecture entitled "Science during the French Revolution," at the Carnegie Institution of Washington. On November 22, Dr. Arthur L. Day gave an illustrated lecture on "The Hot Springs of New Zealand."

SIR RICHARD GREGORY gave early in November the first of a series of five lectures on "Religion as a Social Force" in the Senate House of the University of London. His lecture was entitled "Religion and Science." The other lecturers and their subjects are: Sir Eric Maclagan, on "Religion and Art"; Dr. T. H. W. Armstrong, on "Religion and Music"; Lord Stamp, on "Religion and Business," and the dean of St. Paul's on "Religion and Philosophy."

THE annual fall meeting of the American Mathematical Society will be held this year in Cleveland on November 25 and 26 with Case School of Applied Science and Western Reserve University acting as joint hosts. Approximately 100 delegates are expected to attend the sessions on Friday afternoon and Saturday morning in the Bingham Building of the institute. A convention banquet for the delegates and their wives will be held on Friday evening at 6:30 in Hayden Hall of Western Reserve University. The principal speakers for this year's meeting will be Professor C. C. MacDuffee, of the University of Wisconsin, and Professor V. G. Grove, of the Michigan State College.

THE Society of Rheology will hold its tenth annual meeting on December 28 and 29 at the Mellon Institute of Industrial Research in Pittsburgh. Technical sessions will be held on the two mornings of the meeting, and on the afternoon of December 28 there will be a joint meeting on "Fluid Mechanics" with the Chemical Engineering Symposium of the Carnegie Institute of Technology. The annual dinner will take place on the evening of December 28, and the business meeting will follow luncheon on December 29.

IT is reported in *Nature* that the twenty-fourth meeting of the Australian and New Zealand Association for the Advancement of Science will be held at Canberra from January 11 to 18, 1939, under the presidency of Professor Ernest Scott, emeritus professor of history in the University of Melbourne. Six men of science from Great Britain have accepted invitations to attend this meeting. They are: Professor F. T. Brooks, Sir John Flett, Dr. Julian Huxley, Sir John Russell, Dr. N. V. Sidgwick and H. G. Wells. The presidents of the sections are as follows: Astronomy, Mathematics and Physics, Professor T. Parnell; Chemistry, W. Russell Grimwade; Geology, Professor R. Speight; Zoology, E. J. Goddard; History, Professor S. H. Roberts; Anthropology, F. E. Williams; Economics, Statistics and Social Science, L. G. Melville; Engineering and Architecture, Sir Henry Barraclough; Medical Science and National Health, Dr. E. Sydney Morris; Education, Psychology and Philosophy, J. R. Darling; Agriculture and Forestry, Dr. W. L. Waterhouse; Veterinary Science, Dr. L. B. Bull; Botany, Professor J. G. Wood; Physiology, Professor W. J. Young; Pharmaceutical Science, Dr. E. M. Watson; Geography and Oceanography, G. A. V. Stanley.

THE New York Academy of Sciences has reduced the active membership dues from ten to five dollars a year, to take effect on January 1. Also a new grade of membership has been established for active members desiring to continue their present support of the academy, to be known as sustaining membership. The annual dues for this grade will be ten dollars a year. Such members will receive, each year, a part of the Puerto Rico Survey, in addition to all current numbers of the annals and other publications of the academy, which active members will continue to receive as formerly. After having paid annual dues of ten dollars

for twenty-five successive years, sustaining members have the additional privilege of requesting transfer to the life membership class without further payment of dues.

LORD NUFFIELD has given £25,000 towards a fund to enable the British Institution of Production Engineers, of which he is the president, to proceed at once with the creation of its proposed Production Engineering Research Department, under the charge of Professor Georg Schlesinger.

THE University of Oregon Medical School at Portland, one unit of the Oregon State System of Higher Education, is the recipient of three substantial gifts for instructional and research facilities. The Julius L. Meier family has given $50,000 as a memorial to former Governor Julius L. Meier to be used in supplementing a state appropriation of $110,000 and a PWA grant of $130,909 in the erection of a tuberculosis hospital on the campus of the Medical School and as a part of the university hospitals and clinics. Margaret M. Widmer and Gertrude D. Widmer, graduates of the university, have given the Medical School a farm valued at $30,000, the income to be used in research on heart disease and cancer, the endowment to be known as the "Widmer Memorial Research Fund of the University of Oregon Medical School." Dr. John E. Weeks, of Portland, recently gave $100,000 toward the construction of a medical library, auditorium and laboratory building. This gift was matched by the Rockefeller Foundation, and a grant was secured from the Public Works Administration for an additional $163,350, thereby making it possible to erect a building costing $363,350. The structure will provide the most modern facilities for a large medical library, an auditorium seating six hundred for student and professional gatherings, and a laboratory unit for medical research. Construction on the new tuberculosis hospital and the library, auditorium and laboratory building is now under way.

THE Hall of Pharmacy at the New York World's Fair of 1939, constructed at the cost of $1,000,000, was dedicated on the afternoon of Sunday, November 13. The hall occupies 45,000 square feet of space, sufficient to accommodate several score exhibitors.

THE Kansas State Herbarium has now been transferred to a large fireproof vault on the grounds of Kansas State College, at Manhattan. This herbarium was started in the 1870's by W. A. Kellerman, greatly augmented by A. S. Hitchcock up to 1901, and further enlarged under its present curator, F. C. Gates, during the past twenty years. The collection contains about 90,000 sheets and is particularly full from each of the various counties of Kansas.

AT the U. S. Geological Survey, plans have been made for starting immediately the construction, repair and improvement of river measurement stations, for which $590,000 of Public Works funds have been allocated. Such work will be performed in practically every state in accordance with the approved allotments by states and handled through the district offices of the Geological Survey. Similar arrangements have been made for commencing immediately the Public Works program relating to the surveys of floods and droughts for which $100,000 has been appropriated. Field work has been started on the following PWA projects of the Geologic Branch: Investigations of manganese deposits in the Olympic Mountains, Washington; of phosphate deposits in Wyoming; and of mineral deposits in Strawberry Valley, Utah, and in the Henry Mountains, Utah; and classifications of coal lands in Wyoming and Montana. These projects are in charge of C. F. Park, W. W. Rubey, A. A. Baker and Charles Hunt, respectively.

THE *Journal* of the American Medical Association reports that committees representing Cornell University Medical College and the University of Havana Faculty of Medicine have arranged for exchange students and teaching staff for periods of study. Four undergraduate students and/or members of the teaching staff of Cornell will study parasitology, tropical diseases or any other subject of special interest for six weeks in the summer in Havana under the auspices of the university. Three undergraduates in medicine and/or members of the teaching staff of the University of Havana will have the opportunity of studying at Cornell for a period of eight weeks, one each in the fall, winter and spring. Each university agreed to grant to each visitor on satisfactory completion of the work a certificate covering the studies pursued and the time employed thereon. The studies at the respective schools will be supervised by special committees. Dr. Wilson G. Smillie is chairman of the committee at Cornell and Dr. Alberto Inclán of the one in Havana. The agreement is in effect for one year.

DISCUSSION

WHY WE SELDOM SEE A LUNAR RAINBOW

THE fact that we see the lunar rainbow only once to the hundred times, more or less, that we see the sun-caused, or solar, bow, we instinctively attribute to the great difference between the brightness of the sun and that of the moon. The brighter the light the brighter the bow, of course, other things being equal, and the brighter the bow the more likely we

are to see it. Q.E.D., as Euclid used to say when he had clinched the argument. In this case, however, the argument isn't yet clinched. If the relative frequencies of the solar and lunar rainbows were merely a question of the comparative brightnesses of the two luminaries, we then should expect to see halos, kindred phenomena, about the sun far more frequently than around the moon, but that does not appear to be their ratio. Many people insist that though the sun is up all of every day and the moon below the horizon half, on the average, of every night, still they see the lunar halo more frequently than the solar and claim at the same time that they are awake all day long and asleep through most of the night. This contrast—the fact that the lunar halo is (or seems to be) more frequently seen than the solar halo—is owing, largely at least, to the fact that at night there is no blinding glare from the light of the sky, while in the daytime it often is so intense as to discourage close observation, and to render relatively inconspicuous local intensifications, such as constitute the halo. This is evidenced by the fact that solar halos, and solar coronas, especially, are much more conspicuous when seen in a black mirror, or even in a quiet puddle of dirty water, than when viewed directly in the sky.

But our concern here is with the rainbow, not the halo, which got into the argument surreptitiously. Obviously a lunar rainbow would be faint beyond detection if produced under the same conditions by which the solar bow could just be seen; but on the other hand if the two bows were intrinsically equally bright the night bow might still be clearly seen while the daytime one was lost in the ever-present glare. However, the glare from the region about a rainbow generally is far less than that caused by the thin clouds in the neighborhood of a solar halo. Hence it would seem that if the brightness of the parent luminary and the glare of the sky were the only things that affected the visibility of a rainbow the advantage then would be decidedly with the solar bow. And there are other conditions that intensify this disparity, as will appear from a consideration of the fact that a bow can be seen in only that portion of the rain which is directly illuminated by the sun or moon. This means that the rain cloud is of quite limited extent, at least on the side facing the luminary—not extensive enough to shade the falling rain in which the bow appears. Hence a local convectional shower is more likely than any other to give a rainbow display. Now, over land, where people live anyway, the large majority of such showers occur in the summer afternoon, a time when the sun has every chance to produce a bow and the moon no chance at all.

Furthermore, the most likely time for the appearance of a lunar bow is when the moon is nearly full, and as early as possible after dark, that is, before a local or heat thunderstorm has fully rained out. That particular time, then, is from 8 to 10 o'clock P.M. This means that in mid latitudes, at least, the moon bow is most likely to be seen to the west of the observer. But normally, owing to the fact that the winds are prevailingly from the west and grow stronger with increase of height, the sky is too much covered with blown cloud to the east of the storm to allow direct light from sun or moon to reach the falling rain.

Finally, the moon is in the right phase during the right hours only 3 days, or so, each month, while the sun, always in full glow, is in the proper position every day.

In short, therefore, over land solar bows are far more frequent than lunar bows because:

1. The sun is many times brighter than the moon.
2. The local, or rainbow, shower occurs most frequently in the afternoon and far less often at night.
3. Sunshine often can reach the west or (commonly) windward side of a local shower, the side of least canopy, whereas the light from a nearly full moon, coming from the east, is likely to be intercepted by a layer of cloud.
4. Finally, the sun is in condition and position suitable for the production of a bow every day, and the moon one tenth of the days.

The moon then has such a poor chance to produce a conspicuous bow that it is a wonder that anybody ever sees one, and most people never do. What that chance is can be computed a little closer, perhaps, than one can just guess it. Consider the central portion of the United States. Here about 50 thunderstorms are recorded per year from any given point, but of these only 15, at most, bring rain to the place of observation. Furthermore, it would be liberal, perhaps, to assume that 5 of these occur at night. Again, the moon is in the proper phase and position to produce a rainbow on only one tenth of the nights. Thus far, then, the chance of a lunar bow has been reduced to one in two years. But that is not all, probably only once in 5 times is the sky clear enough in front of a night thunderstorm to permit full illumination of the oncoming sheet of rain; and, finally, from the fact that most of the solar bows are faint it would seem that only one third, at most, of the lunar bows can be visible. Hence once in 30 years is about as often as a close observer in the central portion of the United States may expect to see a lunar rainbow, and as most of us are likely to miss at least three out of four such bows that might be seen, the average inland dweller is lucky if he ever sees one.

However, along certain coasts, and over particular oceanic regions, the chance of seeing a lunar rainbow, and solar bow too, for that matter, is better than it is far inland, because there the passage of cold air starts

at any time a convection shower with a rather limited cloud canopy.

Nevertheless, conditions 1 and 4, above, are the same there as on land; hence even over the ocean the lunar bow is a comparatively rare phenomenon.

W. J. HUMPHREYS

U. S. WEATHER BUREAU,
WASHINGTON, D. C.

OBSERVATION OF A LUNAR RAINBOW BY FRANKLIN

WHILE reading Carl Van Doren's biography of Benjamin Franklin I was reminded of Professor A. K. Lobeck's report (SCIENCE, August 26, 1938) on his observation of a rainbow at night. In 1726, at the age of twenty Franklin kept a journal of his return trip from England to America. The *Berkshire* sailed into the Channel on August 5. Under the date of Tuesday, August 30, young Franklin recorded that "the moon being near full as she rose after eight o'clock, there appeared a rainbow in a western cloud, to windward of us." He also had the experience on this trip of witnessing an eclipse of the sun and an eclipse of the moon just fifteen days apart.

RAYMOND L. HIGHTOWER

KALAMAZOO, MICH.

FREQUENCY OF LUNAR RAINBOWS

A RECENT note by Lobeck recognizes the fact that to most continental residents a lunar rainbow is a distinct novelty.[1] Lobeck also infers greater frequency of lunar rainbows in the trade wind belt, due to thunder squalls. However this may be, it is the purpose of this note to point out that both solar and lunar rainbows are relatively frequent in occurrence in the Hawaiian Islands, where most of the geographically variable rainfall is of orographic origin, *i.e.*, due to cooling of trade winds in passing over rugged island topography. Here, where local showers and mists occur sporadically on days and nights which are generally clear, are ideal conditions for rainbows, and persons in certain localities probably see rainbows almost daily at certain seasons. Any one who has occasion to travel about in upland districts ordinarily sees two or more rainbows a week. Near the full moon, lunar rainbows are often seen and certainly the matters of common knowledge to young and old in this part of the United States. In the solar rainbow, the secondary spectrum is visible more often than not, and the writer has a persistent impression of having seen the secondary spectrum in a lunar rainbow, but can not offer date or systematic observations.

CHESTER K. WENTWORTH

BOARD OF WATER SUPPLY,
HONOLULU

[1] A. K. Lobeck, SCIENCE, 88: 2278, 187, 1938.

MASTODON DISCOVERED IN OHIO

EARLY in September, 1938, a part of the skeleton of a mastodon (Americanus) was unearthed in a field by an Amish farmer, J. J. Miller, who was digging a drainage ditch. The remains consist of a thigh bone and eight teeth, the largest of which weighs a little more than 6 pounds. The remainder of the skeleton was so badly decomposed that it could not be recovered. About ten years ago, during the excavation of a drainage ditch on the same site, the skeleton was partially destroyed by dynamite. It interfered with the digging, and the farmer, not aware of the nature of the obstruction, used the explosive to remove it.

The plot of ground on which the bones were found is located on the extreme western end of the area known as "The Plains" in Berlin Township in Holmes County, Ohio, about two miles southwest of Benton and three miles northwest of Berlin. "The Plains" is already noted for the discovery of the skeleton of a giant sloth, Megalonyx (Jeffersoni), in 1890, on the farm of Abraham Druschell. This specimen, an excellent one, is mounted and stands in the Geological Museum in Orton Hall at Ohio State University.

The remains of the giant sloth were found embedded in shell marl, beneath six feet of black earth. The bones of the mastodon were found lying on top of the shell marl and three feet below the surface beneath black earth, high in humus content. Evidently, the area known as "The Plains" was at one time a glacial lake, which was destroyed by natural processes such as the lowering of the outlet and gradual filling-in by wash and plant and animal accumulations. When finally reduced to a bog, the sloth and mastodon were probably mired in and the skeletons preserved in the bog waters.

KARL VER STEEG

COLLEGE OF WOOSTER

FRESH-WATER MEDUSAE IN TENNESSEE

ON July 15 about a half dozen live *Craspedacusta ryderi* were brought into my office. These had been collected by Miss Sara Betty Fowler from Andrew Jackson Lake, privately owned, at the suggestion of Mr. Harry McCann, custodian.

The lake, about twelve miles west of Knoxville, has an area of from 50 to 65 acres with the greatest depth of from 20 to 30 feet. When we visited the lake on the afternoon of July 15 thousands of the medusae were found at and near the surface of the water. Something like 300 were collected in a short time over a small area. These were placed in an unaerated aquarium. By July 18 most of the specimens remained on the bottom of the aquarium or had disintegrated. Only a few swam irregularly about. Eleven of the more active specimens were preserved. It was found

when these were examined on September 6 that all the eleven were females.

According to Mr. McCann this is the third consecutive year that medusae have appeared in Andrew Jackson Lake. Each time they have lasted about 45 days, at the end of which time they more or less suddenly disappeared. This year they disappeared about August 3 or 4, according to Mr. McCann. None could be found when the lake was visited on August 14. As far as the writer knows, this is the first record of freshwater medusae in Tennessee.

EDWIN B. POWERS

UNIVERSITY OF TENNESSEE

HUNTING IN SOUTH AFRICA

MY attention has recently been drawn to more than one attempt, by advertisement and otherwise, to entice overseas sportsmen to the Union of South Africa with promises of facilities for big and small game hunting. These promises are couched in language that is unjustifiably optimistic, not to say misleading.

There is still much good hunting to be had in many parts of South Africa but mostly on privately owned farms, where in many cases game is carefully preserved. Speaking generally, game is to a great extent strictly protected by law throughout South Africa, particularly in the Transvaal, and permits for shooting certain species of game are only granted in those districts where those particular species are fairly numerous.

Roan antelope are being strictly protected everywhere. Only in special circumstances will permits be issued for shooting oribi, reed buck and sable antelope. Permits to shoot wildebeest, zebra, kudu, impala and waterbuck are only issued in those districts where these animals are sufficiently plentiful. Permits to shoot elephant, hippo, rhino and giraffe are not to be obtained. Even a farm of 10,000 acres well stocked with game might easily be deserted by game, other than birds, after a week or two of intensive shooting, and disappointment is bound to be the lot of many who come to South Africa on the strength of such promises.

Sportsmen who propose visiting South Africa in the hope of getting some big or small game hunting will be well advised to make the closest inquiries before concluding arrangements with persons offering hunting facilities. The Wild Life Protection Society of South Africa is prepared to give advice on game to any one who desires to visit the Union of South Africa on a shooting trip.

J. W. H. WILSON

THE STRUCTURE OF THE INSULIN MOLECULE

IN the article entitled "The Structure of the Insulin Molecule" in the issue of SCIENCE for August 12, two corrections should be made. There should be substituted for "with six slits whose centers give an octahedron," the following: "which by parallel displacement of faces through $\pm a/2$ becomes an octahedron with the same distance between parallel faces and consequently." On page 149, line 16, first column, 66° should be substituted for 6°.

D. M. WRINCH

ABSTRACTS OF PAPERS READ AT THE AUTUMN GENERAL MEETING OF THE AMERICAN PHILOSOPHICAL SOCIETY

AT the autumn general meeting of the American Philosophical Society held in the hall of the society on Independence Square, Philadelphia, on November 18 and 19, the following papers were presented:

Agriculture and current population trends: CONRAD TAEUBER. Reproduction rates in the farm population indicate an excess of approximately two thirds above replacement needs per generation, but rates of reproduction for the non-farm population are not now sufficient for permanent maintenance of present numbers. Within the farm population there is wide variation, rates of reproduction in the native white group ranging from 1.00 in Connecticut to 2.11 in Utah and rates among Negroes ranging from 1.47 in Arkansas to 2.14 in North Carolina. In general, rates are higher in the South than in the North and West; among Negroes and other colored groups than among whites, and among foreign than among native stocks. There is an inverse relationship between level of living and population fertility ratios. While no single factor serves to account for the differentials in the rates of reproduction within the farm population, significance attaches to the nature of the prevailing agriculture. The population engaged in a rationalized, commercial agriculture tends to have lower rates of reproduction and is less elastic for population growth than that engaged in a less commercialized, more nearly self-sufficient agriculture. This relationship is especially clear in areas with approximately the same plane of living; rates of reproduction in the Southern Appalachians tend to exceed those in the Cotton Belt. Changes in farm population between 1930 and 1935 illustrate the same principle. Some of the areas where commercial agriculture is dominant lost population throughout that period, whereas areas with less highly commercialized agriculture more frequently retained their own natural increase and received migrants from non-farm areas.

The social environment as a factor in population

growth: WARREN S. THOMPSON. Not only is there evidence of a general nature that social environment affects the birth rate, but also that a large part of the differences in the birth rates as between individuals and groups are accounted for by the practice of contraception. In industrially backward countries like China, where the mores are favorable to early marriage and the raising of many children, the birth rate is high and seems likely to remain so. In many countries in Europe, notably Germany, a definite attempt is being made to influence the mores or climate of opinion in favor of earlier marriage and larger families. It seems probable that these efforts are having some effect, although it is too soon to speak with assurance. In those parts of the United States where the birth rate remains relatively high, the mores are favorable to raising large families although the economic conditions are not. If the economic motive is the chief motive leading to the practice of contraception, it must be distinguished from necessity, since the birth rate appears to be lowest in the comfortable and well-to-do classes. If the time should come when the community would like to exercise control over the birth rate, it can not do so intelligently unless the motives which actually lead to the practice of contraception have been studied carefully. Until it is clearly known why such a large proportion of the population prefers families too small to insure reproduction, it will not be possible to take measures to change this situation if it is desired to do so.

Intrinsic factors in population growth: FRANK W. NOTESTEIN.

A study of psychological factors in relation to fertility: JOHN C. FLANAGAN.

Voluntary and involuntary aspects of childlessness: CLYDE V. KISER. However important may be the practice of deliberate family limitation among urban couples for the purpose of postponing or spacing pregnancies, it appears that childlessness among women married ten years or more is an involuntary situation. This conclusion seems justified from data recently collected by the Milbank Memorial Fund with the help of the National Committee on Maternal Health. For an exploratory investigation of the problem of childlessness a questionnaire was devised for use among a selected group of married white women residing in four boroughs of New York City, representing all socio-economic classes. The schedule provided for entries concerning previous births and pregnancies. Women reporting that they had never been pregnant were asked to supply information concerning the extent of contraceptive practice since marriage. Furthermore, the childless women were asked to state whether their failure to bear a child had been a disappointment and whether they had ever sought medical advice regarding this condition. A sifting of the returns yielded a group of 291 women who had never been pregnant despite the fact that they had been married ten years or more and were under forty years of age at the time of marriage. Among these, three fourths stated that they had done nothing since marriage to prevent conception, and only 14 per cent. stated that they had regularly and constantly resorted to contraceptive practice. Furthermore, approximately two thirds of the never-pregnant women stated that their failure to have a child had been a disappointment to them, and 57 per cent. stated that they had actually consulted a physician in order to learn why they could not conceive. Similar investigations in other areas are needed for more general results, but it appears that even in a metropolis the practice of contraception can not be held responsible for any major share of permanent childlessness.

Mortality in relation to widowhood: MORTIMER SPIEGELMAN. The general improvement in mortality in the last century has resulted in an appreciable reduction in the chances of widowhood for both man and wife. A married man under age 50 to-day is less than half as likely to lose his wife by death in the course of the year than he would have been one hundred years back; for wives, a corresponding benefit of the same magnitude extends only up to age 40. Since the family is the social unit through which the growth of the population may be influenced, the notable reduction in the chances of widowhood at the young ages of married life, apart from other factors, has, to some extent, enlarged the potentialities for population increase. In the case of native white married women in Pennsylvania, it is found, on the basis of the latest available data (1930), that among wives of ages 20 to 24 the chances of becoming a widow in the course of a year were 2.9 per 1,000; in the age group 30 to 34 years, the chances were 4.8 per 1,000, and, for wives ten years older, namely 40 to 44 years, the chances of widowhood mounted to 9.5 per 1,000. Among men, the chances of becoming widowed in the course of a year were 3.8 per 1,000 in the age group 30 to 34 years; 5.5 per 1,000 in the age group 40 to 44 years, and 9.6 per 1,000 at ages 50 to 54 years. At every age above 34, for a married man, the chances of his own death occurring within one year are greater than the chances of his becoming widowed by his wife's death in that period. Furthermore, his chances of death increase more rapidly with advancing age than his chances of becoming widowed; on the other hand, for a woman beyond age 27, the probability of widowhood within the year is greater than the probability of death; for her, the chances of widowhood increase faster with advancing age than the chances of death.

Technological advance in relation to population trends: WALDEMAR B. KAEMPFFERT.

Prospective development of cultural patterns in rural America and their possible influence on population trends: CARL CLEVELAND TAYLOR.

Anthropological aspects: HARRY L. SHAPIRO.

The heavy electron: KARL K. DARROW. The "heavy electron" is an interesting example of a physical concept now engaged in forming itself under our very eyes. Of electrons, protons and alpha-particles it can be said that their charges and charge-to-mass ratios are determined directly, and serve for defining them; we then observe

whatever other qualities they possess, such as ionizing-power, and associate these with their measured charges and masses. When however a physicist speaks of a heavy electron he is not speaking of a particle of which the charge and the mass have been measured: quite the contrary! Of heavy electrons the charge and the mass can not as yet be measured, and we are forced to base our definition of them upon what for the other particles we regard as secondary qualities. He may be speaking of a particle of which the ability to penetrate great thicknesses of heavy metal is much greater than, according to current theory, that of an electron ought to be. He may be speaking of a set of data which indicate the existence of two distinguishable kinds of particles (the distinction being made on the basis of some other property than charge and mass) where he expected to find one kind only; he may or may not be convinced that one kind consists of electrons, but at any rate he is debarred from believing that both do. In a very few but most significant cases, he can be pretty sure that a particle has exhibited an ionizing-power different not merely from what theory suggests but also from what observation confirms for an electron. Also there is reason for supposing that a particle of mass intermediate between those of electron and proton would be a welcome thing to postulate as a constituent of nuclei. To summarize: there is a variety of mysterious phenomena, of which the mysteries could perhaps be explained by assuming particles of a certain mass between those of electron and proton; if it should finally turn out that the same particle will serve for all, then the heavy electron will be established as a feature of modern physics.

The radioactivity of indium produced by slow neutrons: ALLAN C. G. MITCHELL. Ordinary indium can be made radioactive by exposure to slow neutrons. The source of the neutrons is a mixture of 200 milligrams of radium and 5 grams of beryllium which emits neutrons at a constant rate. Radioactive indium produced by slow neutrons is characterized by three periods: one of 13 seconds, one of 54 minutes and one of 45 days half-life. The period of 45 days is one of the longest ever produced by irradiation with slow neutrons from a radioactive source. Ordinary indium foil was bombarded for *six months* by neutrons from the radium-beryllium source. After irradiation the indium was placed upon a Geiger counter and its activity measured. Aside from the two short periods, already known, the long period was discovered. The activity of the long period was found to be only 2.5 per cent. of that due to the 54-minute period, indicating that it was caused by a substance formed from the rare isotope of indium (4.5 per cent. abundance) by neutron capture. The short periods due to the more abundant indium isotope were investigated after short irradiations. The beta and gamma ray spectra associated with these periods were carefully studied, and it was found that an energy level system could be drawn up which is analogous to the well-known diagrams of this type used in describing visible spectra. Furthermore, the two periods of 13 seconds and 54 minutes, belonging to the same isotope In^{116}, are said to be isomeric. Such isomeric periods can exist only if they have energy levels which are close together and which have quantum numbers differing by a considerable amount. The two energy levels in question were only 0.3 million volts apart. Quantum numbers for all states were assigned.

Adsorption calorimetry and an account of some measurements at low temperatures: RALPH A. BEEBE. The adsorption of a gas on a solid surface may be (1) activated adsorption or (2) van der Waals (physical) adsorption, and only the former of these is in general related to the catalytic activity of the adsorbent material. Because of the great difference in the characteristics of the energy changes occurring during the two types of adsorption, the calorimetric determination of the heats of adsorption provides useful evidence in deciding whether a given process belongs to the activated or the van der Waals type. A vacuum adsorption calorimeter is described which is designed to eliminate the troublesome experimental difficulties arising from the temperature gradients within the instrument. It has been shown that a gas may be held in both the activated and the van der Waals state on the same surface. Frequently the two types occur in well-separated temperature ranges, the activated type being characteristic of the higher temperature. In certain cases, however, activated adsorption is found even at liquid air temperatures occurring concurrently with the low temperature van der Waals process. In the present investigation, heats of adsorption at $-183°$ C. have been measured calorimetrically using the six gases, argon, hydrogen, deuterium, carbon monoxide, nitrogen, and oxygen on a reduced chromic oxide surface. The order of magnitude of the heats indicates that all these gases, except argon, are in part held in a state of activated adsorption as well as in the van der Waals state even at the low temperature of $-183°$. Moreover, in the experiments with carbon monoxide, nitrogen, and oxygen, the complex form of the time-temperature curves on a partially covered surface leads to the conclusion that the adsorbed gas changes over on the surface from an initial van der Waals state to a final state of activated adsorption.

The living state of matter in the range of low temperatures: ALEXANDER GOETZ. It has been proven in the past that small living cells containing little water or being entirely dehydrated (such as spores, certain bacteria, infusoria) can survive temperatures close to the absolute zero. Cells possessing larger quantities of water have a high mortality when cooled due to the crystallization of the cell contents. It is known in general that the transition from a (colloidal) liquid into a solid—when cooled—can take place in two ways: either a crystalline conglomerate is formed where the molecules are aligned into their respective crystal lattices and where consequently the molecular arrangement of the liquid is changed in favor of a thermodynamically stable configuration—or the liquid arrangement is preserved to a large extent in a vitreous solid ("glass"). In this case the substance is thermodynamically not in equilibrium. Which of the two alter-

natives is chosen depends upon the rate of cooling and upon the relative stability of the molecules in the liquid. Applying these principles to live matter one should expect that the possibility for life (viability) should be preservable for all cells if they could be transformed into a vitreous state when cooled. It is probable that the successful freezing experiments are due to the small tendency toward crystallization of dry or nearly dry cells. The author reports experiments with yeast cells where the physical conditions of cooling were especially favorable to cell vitrification, resulting in a reduction of the high cold-mortality to a few per cent. (cooling rates of approximately 1,000 degrees per second, temperatures between $-182°$ and $-252°$ C., special cooling media). In similar experiments a temperature range was found in which devitrification (between ca $-100°$ and 0° C.) takes place in vitrified cells, *i.e.*, a gradual destruction of the "latent" life by the transition of the vitreous state into the crystalline. This phenomenon permits the calculation of a thermodynamical constant descriptive of the live system investigated.

Vascular adjustments of diving animals during apnea: LAURENCE IRVING. When breathing of a mammal is arrested, blood flow decreases through the muscles and increases through the brain. This adjustment of the circulation provides for the respiration of the brain during apnea and appears significant in the endurance of asphyxia. Carbon dioxide is the most familiar single stimulus for respiratory adjustments, and is known to produce a decrease in muscular and an increase in cerebral blood flow in most mammals. In the muskrat and beaver, however, CO_2 does not decrease muscular blood flow as it does in other mammals and therefore would be ineffective in activating the vascular adjustment against asphyxia. In addition, CO_2 is not as effective in increasing the breathing of seals, muskrats and beaver as it is in land mammals. The respiratory adjustments of diving animals resemble those of land animals, except that the divers execute the adjustments quantitatively more effectively. Diving animals show extreme respiratory adjustments, which are nevertheless mammalian in type and which may be used to indicate the small adjustments which land mammals make to avoid asphyxia during apnea. The failure of CO_2 as a respiratory stimulus in divers implies that CO_2 is not effective in activating the quick internal responses which mammals in general make to escape asphyxia during apnea.

The effect of CO_2 in water upon respiration of fish: F. E. J. FRY, E. C. BLACK and LAURENCE IRVING. When the pressure of CO_2 is raised fresh-water fish become more susceptible to lack of oxygen. The catfish is one of the least sensitive to CO_2, and the bass is one of the more sensitive species. Examination in this way of fifteen species of fish from Opeongo Lake, Ontario, shows that each species may be mathematically distinguished by its sensitivity to CO_2. Not only are specific distinctions shown by effect of CO_2, but sex and size differences have appeared as well. The effect of CO_2 conforms to the expectation from known characteristics of the blood, showing a relation to the internal physiological description of respiration. The occurrence of different susceptibilities according to species, size and sex coincides with the fact that fish of a given species, sex and size range together in particular and often restricted environments. The fish examined represent the typical population of a large lake characteristic of the Canadian Pre-Cambrian land surface. This experimental method indicates that we may use known factors of the internal respiratory processes of fish to determine their position and movements in their external environment. The implication is that the known effect of CO_2 upon internal respiratory transport presents the internal sensitivity which activates the fish in selecting a range and that the combination of CO_2 and O_2 in the environment provides the external stimulus which by affecting the internal sensitivity governs their range and migratory movements.

Factors in the progressive depletion of the world's mammalian faunas: FRANCIS HARPER. During the Christian era the world has lost by extinction about 72 forms (species or subspecies) of mammals. They are distributed as follows: Australia, 9; Malay Archipelago, 3; Asia, 4; Europe, 6; Africa, 9; North America, 24; West Indies, 13; South America, none; Falkland Islands, 1; Galapagos Islands, 2; oceans, 1. Approximately 75 per cent. of these losses have occurred during the past century, and 50 per cent. during the past half century. Thus the rate of extinction is being steadily accelerated. In addition to the mammals already extinct, some 350 or 400 others may be considered vanishing forms. Insular faunas, partly by reason of the circumscribed nature of their habitats, are particularly vulnerable to attack or competition by man and by certain mammal pests introduced by him. There may be a further reason for the decadence of insular faunas in some cases, such as that of the West Indies, in the virtually total lack of native mammal predators; these would doubtless have played a beneficial rôle by eliminating the unfit individuals, and thereby contributing to the survival of the fittest individuals, among the species preyed upon. The primary factor in the depletion of the world's mammalian faunas is civilized man, operating either directly through excessive hunting and poisoning, or indirectly through invading or destroying natural habitats, placing firearms in the hands of primitive peoples, or subjecting the primitive faunas of Australia and of various islands to the introduction of aggressive foreign mammals, including fox, mongoose, cat, rat, mouse, and rabbit. Comparatively few species seem to have died out within the past 2,000 years from natural causes, such as evolutionary senility, disease, or climatic change. The chief hope for the survival of the larger mammals of the world lies in the establishment and maintenance of a sufficient number of sanctuaries.

Sex-determination and reproductive economy in the wasp Habrobracon: P. W. WHITING. As viewed from the aspect of modern genetics, sex-determination in insects related to the honey-bee has been very puzzling. The males come

from unfertilized eggs and are therefore fatherless, receiving a single set of hereditary elements from the mother alone. Females developing from fertilized eggs have a double set, one from each parent. The ratio of sex-determining factors should be the same in the double set as in the single, so that it has not been clear what causes sex difference. The small parasitic wasp Habrobracon, a close relative to the honey-bee and having the same peculiar type of reproduction with fatherless males, is easily and rapidly reared in the laboratory and its heredity has been intensively studied. It has been shown that certain abnormal sterile males resulting from inbreeding are not fatherless but develop from fertilized eggs. They have the double hereditary set. Why, then, are they males instead of females? The question has been answered by breeding experiments showing that there are two kinds of normal males, each with different sex-determining elements, X and Y. Females have a combination of the two different male sets, X + Y. The abnormal sterile males produced by inbreeding have either one or the other male set doubled, 2X or 2Y, and therefore have the same ratio of sex-determining elements as the normal males, but the female is necessarily different being a combination X + Y, of the two normal types of males, X and Y. Inbreeding not only results in sterile males, but also in many unhatchable "bad" eggs. The problem as to why these bad eggs and sterile males do not occur in cross-breeding is now being studied.

Mating types, toxic interactions and heredity in Paramecium aurelia: T. M. SONNEBORN. I. *Mating types:* The individuals of *Paramecium aurelia* are of diverse mating types; when the proper types are brought together, they give an immediate agglutinative sex reaction. There are six different mating types, but conjugation occurs only between types I and II, between III and IV and between types V and VI. In any one stock, not more than two types occur, and these are always two that interbreed. The species thus consists of three groups of stocks, with conjugation occurring freely between stocks of the same group, but not at all between stocks of different groups. The three groups of stocks not only contain different pairs of mating types, but also react sexually and conjugate at different temperatures and at different periods of the day. II. *Toxic interactions:* Two stocks produce toxic substances that kill animals of other stocks. The two toxic substances produce characteristically different effects prior to death, and each acts differently on the three groups of stocks of *P. aurelia* and on certain other species of Paramecium. These substances play an important role in natural selection, for, when a stock that produces a toxic substance and a susceptible stock are grown together, the latter is soon completely killed off. III. *Heredity:* Some stocks contain only mating type I, others contain both mating types I and II. The latter condition appears in all hybrids between these two kinds of stocks. In backcrosses to the pure type I parent, the conditions in the two parental stocks segregate in a 1:1 ratio. In the F_2 generation, they segregate in a ratio of 3:1. Inheritance thus appears to follow simple Mendelian rules and to depend upon a single pair of micronuclear chromosomes. In one stock in which two other mating types (V and VI) occur, the inheritance ratio depends upon the temperature prevailing during the process of nuclear reorganization (at conjugation and immediately thereafter). In this case the genetic differences appear to depend on the macronuclei, not the micronuclei; and the type of macronucleus formed depends at least in part on environmental conditions at one stage in the life. Thereafter, the effects are inherited through many fissions until the macronucleus disintegrates.

The Bornean species of the myrtaceous genus Syzygium Gaertner: E. D. MERRILL. In modern times most botanists have considered *Eugenia* Linnaeus as a collective group, although various attempts have been made from time to time to establish generic segregates; approximately 2,500 binomials have been published. A compilation of data appertaining to endemism for various regions in the Old World tropics shows the following: British India (85 species, 53 per cent. endemic); Siam (90 species, 26 per cent. endemic); Indo-China (68 species, 47 per cent. endemic); China (49 species, 55 per cent. endemic); Malay Peninsula (141 species, 60 per cent. endemic); Java (70 species, 45 per cent. endemic); Philippines (182 species, 81 per cent. endemic); and New Guinea (117 species, 85 per cent. endemic). Within the *Eugenia* complex no less than 36 generic segregates have been proposed by this or that author since the genus was established in 1753. With the exception of *Syzygium* Gaertner and *Jambosa* de Condolle, these proposed segregates have not been recognized or adopted by other than the individuals who proposed them. Approaching our problem with a consideration of *Eugenia* Linn. *sensu latiore,* we find that it is possible and practicable to reduce the *Eugenia* complex by the recognition of two small generic segregates for certain Old World species, that *Syzygium* and *Jambosa* can not be distinguished by any single character or combination of characters; that *Eugenia* may properly be restricted to the American species, with a relatively few in the Old World tropics; and for the bulk of the Old World species *Syzygium* is the proper generic name, as this group can be distinguished from the New World *Eugenia* by definite flower, seed and inflorescence characters. The Bornean species now approximate 160 species, of which 45 representatives of *Syzygium* are described as new.

White River Artiodactyla: WILLIAM BERRYMAN SCOTT. The White River was the first of the Tertiary time divisions in which the Artiodactyla became the predominant type of mammals. Eight families of Artiodactyla have been defined in the White River beds, and six of these are extinct, having left no descendants behind them. The two families which are still in existence are, first, the peccaries or wild swine and, secondly, the camels, which for the remainder of the Tertiary period were one of the most abundant of the North American groups. Within the camels there were several distinct, more or less parallel, tribes or phyla, which ultimately led to the grotesque

giraffe-like camels at one extreme, and the small, exceedingly slender, gazelle-like camels at the other. The six extinct families are all exceedingly bizarre creatures, which had incredibly small brains, a feature which no doubt was important in leading to their extinction. These families are described in the forthcoming monograph in considerable detail, and it has become possible to classify them in a satisfactory way.

Evidence for a logical sequence of roof types on Maya buildings at Piedras Negras: LINTON SATTERTHWAITE, JR. The Maya Indians were the most southeasterly of several groups of great temple builders in what is now Mexico and Guatemala. Apart from several beautiful architectural styles, not considered in the paper, the unique Maya contributions to Middle American architecture were the corbeled masonry vault as roof support and great ornamental towers or "combs" rising from the roofs. The earliest known Maya temples and palaces were roofed with thatch—that is, palm leaves laid like shingles on peaked wooden frames or trusses. Excavations of the University Museum, University of Pennsylvania, have shown that at Piedras Negras, Guatemala, a ruined Maya city, less than half were roofed with the masonry vault. Earlier buildings had been destroyed to make way for these vaulted buildings. Other evidence is referred to which indicates that the city grew to full size before vaulted roofs were introduced. During the work of the 1937 season, prosecuted with the aid of a grant from the American Philosophical Society, the ground plans of several temples of the pre-vault period were worked out. To become intelligible the plans require us to suppose that roof-combs once rose from the thick foundation masses forming the rear walls of the temple chambers. With these combs in place a nearly flat plastered concrete roof in turn becomes necessary for a probable reconstruction of the fallen roofs. Lacking the vault, these must have been supported on horizontal wooden beams. The paper discusses briefly the relative advantages and limitations of vaulted and beam-and-concrete roofs, their distributions and datings in Middle America and the elements of which they are composed. Evidence is presented for believing that at Piedras Negras all the structural principles, materials and techniques necessary for building beam-and-concrete roofs were known in early times when temple roofs were still being thatched. It is concluded that the Maya may have borrowed the beam-and-concrete roof from Mexican neighbors in early times; or that they may themselves have invented it, as well as the vault. In either case roof types probably first appeared in the Piedras Negras district in the order (1) thatch, (2) beam-and-concrete, (3) vault. In this order roofs became increasingly permanent and increasingly difficult and costly to build.

The excavation of Tell el-Kheleifeh (Ezion-geber) by the American School of Oriental Research: MILLAR BURROWS. The archeological survey of Transjordan by Nelson Glueck, director of the American School of Oriental Research at Jerusalem, showed that there was extensive copper mining and smelting in the Arabah during the Early Iron Age. This recalled the biblical account of commercial activities under Solomon, including the establishment of a seaport at Ezion-geber on the Red Sea. Iron Age pottery found at Tell el-Kheleifeh, near Aqabah, pointed to this as the site of Ezion-geber. Preliminary soundings were promising, and the American Philosophical Society awarded a grant for excavation, which Glueck carried on during March, April and May of this year. Remains of mud-brick buildings belonging to four periods of occupation, from before the time of Solomon down to the seventh or sixth century B.C., were uncovered, including an elaborate copper refining plant, with extraordinary flues and drafts. Small finds indicate that the manufacture of copper and iron implements was practised also. Imported objects attest the active commerce by ship and caravan for which this port was a center. Further witness of commercial relations is borne by a jar inscribed with South Arabian characters. An Edomite inscription on a jug and eleven impressions of the seal of "Qaus-'anal, servant of the king," on jar-handles of the seventh or sixth century B.C. were found. The pottery, while related to that of the Early Iron Age in Palestine and more closely to the Edomite pottery hitherto found in Transjordan, is in some respects distinctive. Ledge and horn handles, not elsewhere found in this period, are especially characteristic. About two thirds of the mound, including the highest part, remain to be excavated. A second campaign is planned for next spring, if possible.

The Ihyā' 'Ulūm al-Dīn of al-Ghazzāli: NABIH AMIN FARIS. The *Ihyā' 'Ulūm al-Dīn* is the *magnum opus* of al-Ghazzāli, the greatest Moslem theologian after Muhammad and one of the noblest and most original thinkers of all time. He may be likened to Thomas Aquinas, whom he influenced, but his personal contribution to the theology was more considerable than that of Aquinas. He also influenced Pascal and left his impress on Christian and Jewish scholasticism in general. The *Ihyā' 'Ulūm al-Dīn* consists of four large volumes and contains more than a thousand closely transcribed manuscript pages of the folio size. The first two volumes treat of the outward forms of worship, while the last two deal with the inward nature of religion. In it al-Ghazzāli grafts mysticism onto Islam and establishes its orthodoxy. For this reason he has been called the St. Augustine of Islam. Through this book al-Ghazzāli led the Moslems back from scholastic labors upon theological dogmas and minutiae to living contact with the Word. Through it he insured for Sufism a firm and permanent position in the "Church" of Islam. Above all, through it he brought philosophy and philosophical theology within the range of the ordinary man. The unique position which it occupies among the Moslems is summed up by the words of Hājji Khalīfah, the foremost Turkish writer of the seventeenth century, who said: "Should all other Moslem writings be destroyed, the *Ihyā'*, if spared, would make up for all the loss." Consequently, alongside of the ossified system of the traditionalists, the *Ihyā'* is earnestly studied; and in that study, without doubt, is the hope for the future of Islam.

Musical composition by American Moravians from 1742–1842: ALBERT G. RAU and HANS T. DAVID. An appropriation from the Penrose Fund of the American Philosophical Society was made to the Moravian Seminary and College for Women, of Bethlehem, Pa., for the purpose of making a critical catalogue of original compositions by American Moravians during the one hundred years from 1742 to 1842. Out of a mass of two thousand or more manuscripts found in various Moravian churches in Pennsylvania, Maryland and North Carolina, we secured some four hundred that were original compositions made in this country by sundry Moravian musicians for the enrichment of the liturgical seasons of the church. Most of these are anthems for four or eight voices, with orchestral accompaniment of strings, with the addition also of wood wind and brass in some cases. Of the ten men whose works we examined, five were born on this continent. The obvious musical continuity in the series indicates a transfer of musical technique from the older to the younger workers in very evident fashion. Only a few of the works are secular, but these are extremely interesting. Among them is a series of Parthien or suites for wind instruments, obviously used for serenading purposes, and a group of six quintets for two violins, two violas and violoncello, which have been definitely determined to be the oldest compositions in sonata form composed in America.

SPECIAL ARTICLES

THE OCCURRENCE IN NATURE OF "EQUINE ENCEPHALOMYELITIS" IN THE RING-NECKED PHEASANT

THREE pheasants were received for diagnosis on October 6, 1938, from a locality in Connecticut. These birds had been on range and were found in a more or less helpless or partially paralyzed condition and died before being shipped. The sender, Mr. Edward H. Mulliken, reported the finding of dead wild birds as well as pheasants following the hurricane of September 21. These pheasants presented no gross lesions, though the brain substance was rather soft. This was attributed to post-mortem change, the birds having been three days in transit. In view of the paresis that had been observed, the brain of each was inoculated into white Swiss mice intracerebrally in groups of 4 to 6, using large animals about six months old. All these mice were either dead or moribund on the fourth day, there being no noticeable difference in the course of the infection in any of the three groups.

A fourth pheasant was found sick in the same region and was received dead on October 18. There was a caseous mass around the gall bladder, which had evidently been ruptured. A suspension of the brain of this bird also killed large Swiss mice on intracerebral injection in from 4 to 5 days. This strain was carried through a second passage in mice.

Culture media inoculated with infective brain from mice of each of these groups furnished no growth either on gross or microscopic examination. The infection from one of these four pheasants was chosen arbitrarily for serial passage in mice. Young Swiss mice weighing 12 to 15 grams died in about 48 hours after intracerebral and in 3 to 4 days after intraperitoneal injection. Many of the animals developed a flaccid paralysis of the hind legs, though a few showed hyperexcitability. Occasionally a mouse, apparently well, would go into a convulsion, leap into the air and die a few minutes later after the manner of mice infected with herpes. This strain has been carried through 10 passages in mice. The titre of the virus in the brain is high; the intraperitoneal injection of 0.2 cc of a 1 to 10,000,000 dilution of infective mouse brain killed 1 of 6 mice. Guinea pigs, injected subcutaneously or intraperitoneally with a heavy suspension of infective mouse brain, died within 2 to $4\frac{1}{2}$ days.

The course of the pheasant infection in mice and in guinea pigs presented characteristics which are strikingly similar to those of equine encephalomyelitis. Dr. Peter Olitsky, of the Rockefeller Institute, kindly supplied serum of a rabbit immune to eastern encephalomyelitis. Small amounts of this serum (0.1 cc) afforded complete protection to mice against 100,000 minimal infective doses of virus of the pheasant strain. The virus and serum were mixed and injected intraperitoneally, without preliminary incubation, into young Swiss mice (12 to 15 grams).

A few tests have been made of the susceptibility of other birds to the virus from the pheasant, using an inoculum of infective mouse brain. Two adult quail which were injected intracerebrally died after 4 and 5 days and the virus was recovered by the inoculation of brain tissue into mice. Of two injected subcutaneously, one died after 5 and the other after 10 days. Mice remained well following inoculation with the brain tissue of the quail dying after ten days. Therefore, the cause of death in this bird is doubtful. Fifteen newly hatched Rhode Island Red chicks were obtained. The virus was carried serially in these chicks through 4 passages, chiefly by subcutaneous injection. In the first and second passage all the chicks died, but in the third and fourth the course of the infection became progressively more uncertain. Six chicks injected intracerebrally died in about 48 hours; 9 were injected subcutaneously and 7 died at varying intervals. The virus was recovered by the intracerebral injection of mice with the brain tissue of a chick dying in the fourth passage after subcutaneous injec-

tion. The susceptibility of young chicks and of adult birds of other species makes entirely understandable the massive concentration of the virus of equine encephalomyelitis which develops in chick embryos as contrasted with the low titre of the virus in the brain of horses. The susceptibility of many birds to certain strains of encephalomyelitis has been demonstrated experimentally; notably the pigeon,[1] a species of vulture, the stork, the duck, the goose, the European blackbird and the common harrier of Europe.[2]

On preliminary study of stained sections of brain and cord of the pheasant infected in nature, perivascular lesions are found distributed unevenly throughout the cerebrum and there is also a meningitis. Around the small blood vessels there are prominent infiltrations composed of lymphocytes, plasma cells and large mononuclears. Cells of the same types occur in the pia. Polymorphonuclear cells are so rare as to be demonstrable with difficulty. The brains of inoculated quail and chickens show less conspicuous lesions. The cerebrum of the infected guinea pig presents numerous ill-defined foci of polymorphonuclear infiltration, distributed superficially in the brain substance. The lesions of the mouse brain are less obvious and are chiefly of a degenerative nature.

Summary: The recognition of a series of cases of equine encephalomyelitis in pheasants adds valuable information concerning the distribution of this disease, and the designation "equine" becomes an unfortunate misnomer. Indeed, it may be seriously questioned whether the horse or other domestic animals play any essential role in assuring the perpetuation of this disease. The present demonstration of the natural occurrence of the infection in game birds and the experimental evidence obtained by Remlinger and Bailly of the susceptibility of migratory birds to certain strains of encephalomyelitis suggest an easy mode for the wide distribution of this virus. A search for spontaneous infection in migratory birds is indicated. Extensive surveys will be required in order to know just how widely the infection is spread in nature. It may be only under accidental circumstances or when the infection rises to a certain level that it overflows and becomes a serious problem as regards the horse and even the human being.

ERNEST EDWARD TYZZER
ANDREW WATSON SELLARDS
BYRON L. BENNETT
DEPARTMENT OF COMPARATIVE PATHOLOGY AND TROPICAL MEDICINE, SCHOOLS OF MEDICINE AND PUBLIC HEALTH, HARVARD UNIVERSITY

[1] L. T. Giltner and M. S. Shahan, SCIENCE, 1933, 78: 62, 1933.

[2] P. Remlinger and J. Bailly, *Compt. Rend. Soc. Biol.*, 120: 1067, 1935; *ibid.*, 121: 146, 1936; *ibid.*, 122: 518, 1936; *ibid.*, 123: 562, 1936.

THE ABSORPTION OF CARBON DIOXIDE IN PHOTOSYNTHESIS

IT is often stated that enzymatic processes are reversible. It is also a commonplace that photosynthesis is in many respects the reverse of respiration. Now there is every reason to believe that the CO_2 formed in oxidations arises from organic acids, probably by the same reactions as in fermentation, namely, from pyruvic acid by the action of carboxylase, from formic acid by the hydrogenlyase, from oxalacetic acid in its breakdown to pyruvic acid, from acetoacetic acid in the acetone fermentation, etc. What could be more natural than to suppose that in photosynthesis the absorption of carbon dioxide takes place in the reverse way, by combination with an aldehyde, or, more probably, with an organic acid, to produce a new carboxyl group? Specifically, a probable reaction is the combination of CO_2 with pyruvic acid to produce oxalacetic or perhaps with lactic acid to produce malic. The light reaction would then be the reduction, not of CO_2 as such, but of the carboxyl group.

This simple assumption would make the first reactions in photosynthesis much easier to comprehend. It is usually assumed, following Willstätter and Stoll, that the CO_2 combines with the chlorophyll, but for this there has never really been sufficient evidence. For formaldehyde ("activated" or otherwise) as the first reduction product of CO_2 there is even less evidence, and the persistence of these unsupported theories must be ascribed to the absence of any plausible substitute. It is hoped that the suggestion here made may provide a working hypothesis which at least is consistent with a number of facts.

Both in photosynthesis and chemosynthesis there is evidence pointing to such a reaction. In the *Athiorhodaceae,* in light, Gaffron[1] showed that CO_2 is absorbed in presence of mono- or di-carboxylic acids and there was a corresponding disappearance of carboxyl groups. In the *Propionibacteriaceae,* Wood and Werkman[2] have shown that CO_2 is absorbed, non-photosynthetically, probably by combination with an organic acid. The reversible equilibrium between CO_2, hydrogen and formic acid in *bacterium coli*[3] is also suggestive. Whether or no we may safely generalize from individual biochemical processes, it is a remarkable fact that recent work gives increasing evidence for the role of intermediate products themselves as catalysts or carriers in a catalytic cycle. There is the action of arginine in the formation of urea,[4] the dicarboxylic

[1] H. Gaffron, *Biochem. Zeit.*, 260: 1, 1933; 275: 301, 1935.

[2] H. G. Wood and C. H. Werkman, *Biochem. Jour.*, 30: 48, 1936; 32: 1262, 1938.

[3] D. D. Woods, *Biochem. Jour.*, 30: 515, 1936.

[4] H. A. Krebs and K. Henseleit, *Zeit. Physiol. Chem.*, 210: 33, 1932.

acid hydrogen carriers of Szent-Györgyi and co-workers[5] and the acetic-succinic-pyruvic-acetic cycle, while the cyclic processes of alcoholic and lactic fermentation are closely comparable. The combination of CO_2 with an organic acid, the photo-reduction of the carboxyl group and the consequent intramolecular changes leading finally to the setting free of the organic acid again, would be just such a cycle. Doubtless some of the organic acid would be reduced to sugar in each cycle.

These considerations suggest an important connection between photosynthesis and organic acid metabolism, a connection which, to the writer's knowledge, has never been investigated. If photosynthesis were to require a small supply of organic acid as intermediate, this would explain such observations as the failure of isolated chloroplasts to photosynthesize. In any event, it is believed that investigations along the above lines would be profitable.

KENNETH V. THIMANN
HARVARD BIOLOGICAL LABORATORIES,
CAMBRIDGE

AIRPLANE COLLECTIONS OF SUGAR-BEET POLLEN

THE localized area in the Rio Grande Valley in southern New Mexico in which sugar beets were being grown for seed production in 1938 afforded opportunity for making collections to determine presence of sugar-beet pollen at various altitudes. The area planted to sugar beets for seed comprised about 900 acres and was concentrated into a few districts lying between El Paso, Texas, and Las Cruces, New Mexico. Source of the sugar-beet pollen caught was assignable with some sureness, since no other sugar beets were grown within a 125-mile radius. The period of flowering of the sugar beet extended from late April until the middle of June, the height of blooming being between May 15 and June 1.

Through the cooperation of the U. S. Army Air Corps an airplane flight in the general region of concentration of beet fields was made on June 3, 1938, by Major Guy Kirksey, commanding officer at Biggs Field, El Paso, Texas, with F. C. Meier as observer.[1] The flight was made from 10:30 A.M. to 1:00 P.M. of a hot, fairly quiet day. Series of short exposures of agar plates were made at the various altitudes.

Flights in other years in this region had indicated presence of sugar-beet pollen fairly high in the air.[2] Special precautions were taken in making the 1938 collections to eliminate possibility of contamination either prior to exposure or during examination of the agar plates. Using 40 per cent. sucrose agar, Petri dishes were prepared in Washington a few days previous to the flight. After solidification of the agar, the covers of the dishes were bound in place by a strip of Cellophane adhesive running across the lid and fastening to the bottom dish. The Petri dishes were also sealed with ordinary surgical adhesive tape to prevent contamination and drying. The small wooden Petri dish holder devised by F. C. Meier was used in exposing the agar plates outside the plane. This holder consists of a circular wooden base about the size of the Petri dish and is fitted with short projecting brass strips which, slipping between the overlapping side walls of the lid and base, clamp the bottom half snugly. In making an exposure the adhesive seal was removed in the cockpit, and the covered Petri dish pushed in place in the holder. The observer held the plate outside the plane with one hand, twisted the top with the other to cut the Cellophane binder and then removed the cover. When the exposure was completed, the lid was replaced outside the plane. The covered dish was then resealed with the surgical adhesive tape in the cockpit.

In order to avoid outside contamination, the exposed plates were taken directly from the landing field to an air-conditioned room for the examinations for presence of sugar-beet pollen. In the systematic study of the plates under the microscope, magnification with the 16-millimeter objective was ordinarily adequate for the identification. Magnification with the 4-millimeter objective to bring out more sharply the characteristic markings of sugar-beet pollen,[3] which differentiate it from allied pollens of somewhat similar size, was frequently used to verify identifications, and also whenever the pollen was more deeply embedded in the agar film. The data obtained from the examination of the plates for the various exposures are given in Table 1.

TABLE 1

SUGAR-BEET POLLEN GRAINS TRAPPED ON AGAR PLATES EXPOSED IN AIRPLANE FLIGHT, RIO GRANDE VALLEY, SOUTHERN NEW MEXICO, ON JUNE 3, 1938

Elevation above valley floor	Number of pollen grains and exposure period in minutes				
	1	2	3	4	5
1,000	–	17	19*	5	15†
2,000	–	–	14	4	7*
3,000	0	3*	7*	4	–
4,000	1; 0	0	–	2	6
5,000	5	2	6	6	9*

* One germinating pollen grain found.
† At least two pollen grains germinating.

Pollen grains were found at all altitudes with the number becoming fewer at four thousand feet. At the 5,000-foot level, which corresponds to the so-called "dust horizon," the number seemed appreciably larger

[5] *Zeit. Physiol. Chem.*, 236: 1, 20, 31, 58, 66, 1935.

[1] The senior author while continuing his research in aerobiology was lost with the Hawaii Clipper on July 29, 1938.

[2] G. H. Coons, U. S. Dept. Agr. Yearbook, 1936, p. 646.

[3] Ernst Artschwager and R. C. Starrett, *Jour. Agr. Res.*, 47: 823–843, 1933.

than for the other altitudes except the lowest at which samples were taken. The plates showed also numerous fungus spores, plant hairs and pollen from other species of plants, notably *Pinus* spp. One pine pollen grain collected at 4,000 feet above the valley floor had germinated on the agar.

It seems at this time desirable merely to record the presence of viable sugar-beet pollen in the air at high elevations without any inferences as to relation to cross-pollination problems of the sugar beet.

FRED C. MEIER
ERNST ARTSCHWAGER

EXTENSION SERVICE
BUREAU OF PLANT INDUSTRY,
U. S. DEPARTMENT OF AGRICULTURE

BASAL DIETS FOR VITAMIN B_1 DETERMINATION

INVESTIGATIONS which are still in progress have demonstrated that it is quite practical to prepare a diet satisfactory for the determination of vitamin B_1 by applying the observation of Williams and coworkers[1] that this vitamin is destroyed by cleavage with sulfite. A basal diet consisting of sucrose, 71 per cent., vitamin B_1 free casein, 18 per cent., salt mixture, 4 per cent., fat, 5 per cent., and cod liver oil, 2 per cent., was used, and various proportions of sucrose were replaced by addenda containing the vitamin B complex.

Sulfite treatment of yeast was carried out as follows: 400 cc of 0.1 per cent. sodium sulfite were added to 50 grams of dried yeast in a 500-cc wide mouth bottle. SO_2 was introduced until a pH of 4 was reached, and the bottle was then stoppered and allowed to stand 5 days at room temperature (25° C.). The contents of the bottle were then dried on purified casein at a temperature not exceeding 65° C.

Rats fed the basal ration containing 5 or 15 per cent. of sulfite-treated yeast, and receiving in addition crystalline vitamin B_1, grew as rapidly as animals receiving the same quantity of untreated yeast in the basal diet. Six animals 27 days old, weighing approximately 40 grams, were fed the basal ration with 15 per cent. of sulfite-treated yeast. Four of these animals developed acute polyneuritis in 32, 33, 34 and 34 days, respectively. Two animals died in 24 and 31 days, respectively, the latter showing slight symptoms of polyneuritis before death. There is reason to believe that with slight modification of the basal diet the percentage of polyneuritis can be increased and animals may be produced which are more suitable for quantitative assay where duration of cure of polyneuritis is used as the criterion.[2]

[1] R. R. Williams, R. E. Waterman, J. C. Keresztesy and E. R. Buchman, *Jour. Am. Chem. Soc.*, 57: 536, 1935.

[2] O. L. Kline, C. D. Tolle and E. M. Nelson, *Jour. Assoc. Off. Agric. Chem.*, 21: 305, 1938.

In the preparation of rations which contain adequate amounts of the members of the vitamin B complex and devoid of vitamin B_1, the destruction of vitamin B_1 with sulfite appears to offer definite advantages over any procedure that has been proposed. Details of an exact procedure are being studied, but because of a widespread interest at present in methods for determining the vitamin B_1 content of foods and pharmaceutical preparations as well as human requirements for vitamin B_1, this preliminary report may be helpful to others.

O. L. KLINE
CHESTER D. TOLLE
E. M. NELSON

FOOD AND DRUG ADMINISTRATION,
U. S. DEPARTMENT OF AGRICULTURE

BOOKS RECEIVED

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